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Radioactive Fallout in the United States

Merril Eisenbud and John H. Harley

Health and Safety Laboratory, U.S. Atomic Energy Commission, New York

THIS report summarizes the data accumulated up to the present time by the fallout monitoring network of the U.S. Atomic Energy Commission (*1*). Having reviewed the information obtained through early 1952 in a previous article (*2*), we now add the data obtained in more recent atomic tests, including the Pacific exercises in the fall of 1952 (Operation Ivy), the Nevada tests early in 1953 (Operation Upshort-Knothole), and the Pacific tests in the spring of 1954 (Operation Castle).

The data are representative of the entire area of the United States except that within 200 mi of the Nevada Test Site. This region is not covered by the monitoring system described here, but the radioactive fallout within this area has been reported in the semiannual reports from the AEC to the Congress (*3, 4*).

Description of monitoring system. When tests are under way in Nevada, the monitoring network consists of 89 sampling stations (*5*), but at other times the number is reduced to 41, a reasonable distribution of sampling sites for the more diffuse radioactive debris that may originate from detonations beyond the continental limits.

Table 1 lists the stations that are operating during the Nevada tests this spring. These stations, with the exception of Cleveland, Ohio, Cape Hatteras, N. C., and Concord, N. H., were also in operation during the 1953 spring tests in Nevada (Upshot-Knothole); those marked with an asterisk were in operation during the Pacific tests conducted in the spring of 1954 (Castle).

The 1-ft² gummed surface previously described (*2*) continues to be used to collect samples. The adhesive is supported on an acetate film mounted horizontally on a frame about 3 ft above the ground. The coating retains its adhesive properties when it is wet, and dust particles that are entrapped in raindrops are collected. The gummed films are changed each day and are mailed to the AEC Health and Safety Laboratory in New York, where their radioactivity is assayed.

The samples are prepared for analysis by ashing at 550° to 600°C. This results in the loss of some volatile isotopes, such as those of iodine and ruthenium, but these comprise less than 10 percent of the total activity. This defect in procedure is justified by the simplicity of the operation.

The small amount of residual ash is transferred to plastic planchets that are sealed between two layers of vinyl tape for automatic beta counting (*6*). These counters have a background of 7 to 10 counts/min and efficiencies of the order of 10 percent. Samples are counted for 20 min, or for 640 counts if this occurs before 20 min have elapsed. Blanks and standards are sealed into every tape. The counts are extrapolated using the $t^{-1.2}$ law to express decay.

This method of monitoring fallout is exceedingly sensitive. We have observed that a general rise in the gamma background of 10^{-4} r/hr is associated with fallout of approximately 10^6 disintegrations/min ft². The counting procedures in routine use in this laboratory permit detection of a daily fallout of as little as 10 disintegrations/min ft². It is thus possible for us to detect radioactivity that produces a general elevation of background of about 10^{-9} r/hr. The normal gamma background count, which is caused by cosmic rays, radiopotassium, radium, and other natural sources of radioactivity, is quite variable in the range of 5×10^{-6} to 5×10^{-5} r/hr. This method thus makes it possible to estimate minute amounts of radioactivity that are insufficient by far to affect measurably the general gamma radiation background of an area.

It is clear that no one sampling procedure provides the ideal method for estimating the deposition of radioactive dust under all conditions. The deposit on any given area will depend somewhat on the character of the surface presented. For example, when there is no rainfall, dry fallout may drift somewhat with other windblown dusts. In this situation the gummed filter technique may yield a high estimate of the average fallout, because it will tend to collect dust that is being redistributed laterally.

We have compared the collection characteristics of the gummed film (G) and a high-walled pot (P). During a 49-wk period we found that the regression of P on G was 1.17 ± 0.19. This is a highly significant relationship that does not differ significantly from 1.

Methods of collection utilizing pots or pans for collection of total rainfall are disadvantageous in practice because of the need to transfer and handle the wet samples preparatory to shipping to a central radiochemical facility. The gummed-film method is uniquely simple—at the end of the sampling period the film is folded and placed with a data card in an envelope for mailing to the Health and Safety Laboratory, where it is processed in the manner described.

The routine operation of this network has been greatly facilitated by the cooperation of the U.S. Weather Bureau, at the stations of which our collectors are placed. Duplicate samples at all stations provide insurance against loss of samples and also give the advantage of replication.

We have discontinued the routine monitoring of air-borne (suspended) dust at all locations. We have previously reported (*2*) that the highest daily mean air-borne dust concentration recorded during the Nevada tests in the spring of 1952 was 23×10^{-3} $\mu\mu c/cm^3$ (equivalent to 53,000 disintegrations/min

m^3) at Elko, Nev., on 1 June. The estimated cumulative dose to the lungs of persons who breathed this concentration is 20 millirads (*7*), somewhat less than the dose from a chest x-ray. We now have the experience gained during a more recent Nevada series of tests, those conducted in the spring of 1953. We collected samples of air extensively during that series, but none was as high as this previously recorded maximum level.

Accumulation of radioactive fallout. Figure 1 gives our estimates in millicuries per square mile of the total fission products deposited throughout the country since early 1951. These estimates are based on approximately 250,000 samples collected since 1951. The accumulation varies from 21 mc/mi² in Arizona to 120 in New Mexico. The mean of the reported values is 61 mc/mi². The spread is rather narrow in view of the many factors that affect the amount of fallout in any given place. Nevada is not included because gradations in the fallout patterns make it impractical to assign a single value for the state.

Table 1. Network of collection stations (Feb. 1955). The stations in operation during Operation Castle, the Pacific tests conducted in the spring of 1954, are indicated by an asterisk.

Mobile, Ala.	Kalispell, Mont.
Montgomery, Ala.	*Scottsbluff, Neb.
Flagstaff, Ariz.	Elko, Nev.
Phoenix, Ariz.	Ely, Nev.
*Tucson, Ariz.	*Las Vegas, Nev.
Yuma, Ariz.	Reno, Nev.
Fort Smith, Ark.	Winnimucca, Nev.
Eureka, Calif.	*Concord, N.H.
Fresno, Calif.	*Albuquerque, N.M.
*Los Angeles, Calif.	Roswell, N.M.
Sacramento, Calif.	Albany, N.Y.
San Diego, Calif.	*Binghamton, N.Y.
*San Francisco, Calif.	*Buffalo, N.Y.
Colorado Springs, Colo.	*New York, N.Y.
Denver, Colo.	(La Guardia)
*Grand Junction, Colo.	*Rochester, N.Y.
Pueblo, Colo.	Syracuse, N.Y.
*New Haven, Conn.	*Cape Hatteras, N.C.
*Washington, D.C.	Fargo, N.D.
(Silver Hill, Md.)	Williston, N.D.
*Jacksonville, Fla.	*Cleveland, Ohio
*Miami, Fla.	*Medford, Ore.
*Atlanta, Ga.	Portland, Ore.
*Boise, Idaho	*Philadelphia, Pa.
Pocatello, Idaho	*Pittsburgh, Pa.
*Chicago, Ill.	Providence, R.I.
*Des Moines, Iowa	Charleston, S.C.
Concordia, Kan.	Huron, S.D.
Goodland, Kan.	*Rapid City, S.D.
*Louisville, Ky.	*Knoxville, Tenn.
*Wichita, Kan	*Memphis, Tenn.
*Louisville, Ky.	Abilene, Tex.
*New Orleans, La.	Amarillo, Tex.
Caribou, Me.	*Corpus Christi, Tex.
Baltimore, Md.	*Dallas, Tex.
*Boston, Mass.	Del Rio, Tex.
Alpena, Mich.	Port Arthur, Tex.
*Detroit, Mich.	Milford, Utah
Marquette, Mich.	*Salt Lake City, Utah
Grand Rapids, Mich.	Lynchburg, Va.
*Minneapolis, Minn.	*Seattle, Wash.
Jackson, Miss.	Spokane, Wash.
*Kansas City, Mo.	Green Bay, Wis.
*St. Louis, Mo.	Milwaukee, Wis.
*Billings, Mont.	Casper, Wyo.
Helena, Mont.	Cheyenne, Wyo.

The manner in which each of the test series has contributed to the total fallout now estimated to be present in the northeastern United States is illustrated in Fig. 2, which continues the type of graphical presentation first used in our earlier report. In order to facilitate the presentation of these data, we have made the simplifying assumption that the debris from each of the detonations of a series of tests originated from a single burst occurring at the midpoint of the series. The total artificial radioactivity continues to be of a low order when it is compared with the radioactivity normally present in the earth's crust. The naturally occurring isotope Ra^{226} is present in amounts that vary between 100 and 1000 mc/mi², considering only the upper few inches of the earth's crust.

Of the various long-lived constituents present in this radioactive debris, Sr^{90} is of most interest. This is because of its relatively long half-life (25 yr) and the fact that its chemical similarity to calcium makes it possible that strontium can enter into biological systems along with calcium and ultimately be deposited in human bone. As is well known, this is also true of radium.

The estimated accumulation of strontium in the soil in northeastern United States is also shown in Fig. 2. The contribution from Sr^{89} is not shown because of its relatively short half-life (55 days). The ratio of Sr^{89} to Sr^{90} in the accumulated debris from all detonations is estimated to have been about 1.0 on 1 Jan. 1955.

By 1 Sept. 1954 the estimate of accumulated Sr^{90} was 1 mc/mi². This estimate is based on the assumption that Sr^{90} is present in the debris in an amount that can be predicted from the data of Hunter and Ballou (*8*). The proportion of Sr^{90} of the debris may vary somewhat from theory, and more or less Sr^{90} may be present. This is consistent with the manner in which Sr^{90} is formed and the general dynamics of the fireball as we presently understand it. The Sr^{90} is derived from a radioactive parent Kr^{90}, which is an inert gas having a half-life of 25 sec. Thus, much of the Sr^{90} that is ultimately present in the debris is formed when the fireball is relatively old and has cooled considerably. This can result in the presence of a disproportionate fraction of Sr^{90} in a given particle of debris. A tentative assumption, supported by incomplete studies, is that the debris which falls out in the immediate vicinity of a detonation is depleted in Sr^{90}. Conversely, the debris that falls out at great distances is likely to be enriched in this nuclide. Re-

cent unpublished analyses from our laboratory suggest that the use of the Hunter and Ballou curves to estimate the radiostrontium content of our samples may yield values that are about 30 percent of the true value. The same reasoning applies to Sr^{89}, which is also derived from a krypton isotope.

However, an upward adjustment, by a factor of 3, of our estimates of the Sr^{90} contribution to the earth's crust does not alter the conclusion that the fallout of long-lived radioactive constituents of the debris has been minute compared with the radioactivity that is normally present in the earth's crust. Bugher (*9*) recently estimated that the amount of strontium present would have to be increased by the order of 1 million times before the biological effects from this cause could be recognized.

In a few places relatively heavy fallout caused by a combination of meteorological coincidences resulted in elevations of the radiation background that were readily detectable with conventional radiation detection equipment. In each case the fallout was associated with precipitation coinciding with the transport of radioactive dust into the rain-forming levels of the atmosphere. The bulk of this radioactivity is eliminated by decay in the matter of hours or a few days after the fallout. At no place except in the immediate vicinity of the test site in Nevada is there a sustained elevation of the background sufficient to be demonstrable by direct measurement of the gamma background in the area. For example, the deposition of mixed fission products in New Mexico is estimated to have been approximately 120 mc/mi² on 1 Jan. 1955. The gamma radiation from this deposition is of the order of 0.0010 mr/hr; the normal background of the United States varies from 0.005 to 0.05 mr/hr and in any one place may vary by as much as a factor of 5, primarily because of meteorological situations that inhibit the dispersion of the radioactive gas radon and its daughter products. It would be difficult, although possible, to measure the increase in dose rate caused by 100 mc/mi².

An example of relatively heavy fallout was the radioactive rain in Troy, N. Y., of April 1953. This instance was particularly well documented by Clark (*10*). Although Troy is located at a great distance from the Nevada test site, the fallout on that city is to our knowledge the highest that has occurred except, as reported elsewhere (*4*), for some of the communities located within 200 mi of the Nevada test site. Clark reported that the cumulative dose from Troy fallout was about 100 mr. It is apparent from this and previous descriptions of methods by which we document radioactive fallout at distances from the site of a detonation that the widespread dispersion of radioactive debris is readily demonstrable by rather simple techniques.

It is not surprising that at times anomalously high fallout at great distances from a detonation has been readily observed by conventional radiosensitive laboratory equipment. It will be recalled that fallout from

Fig. 1. Cumulative radioactive fallout in the United States from the spring of 1951 to 1 Jan. 1955, in millicuries of mixed fission products per square mile.

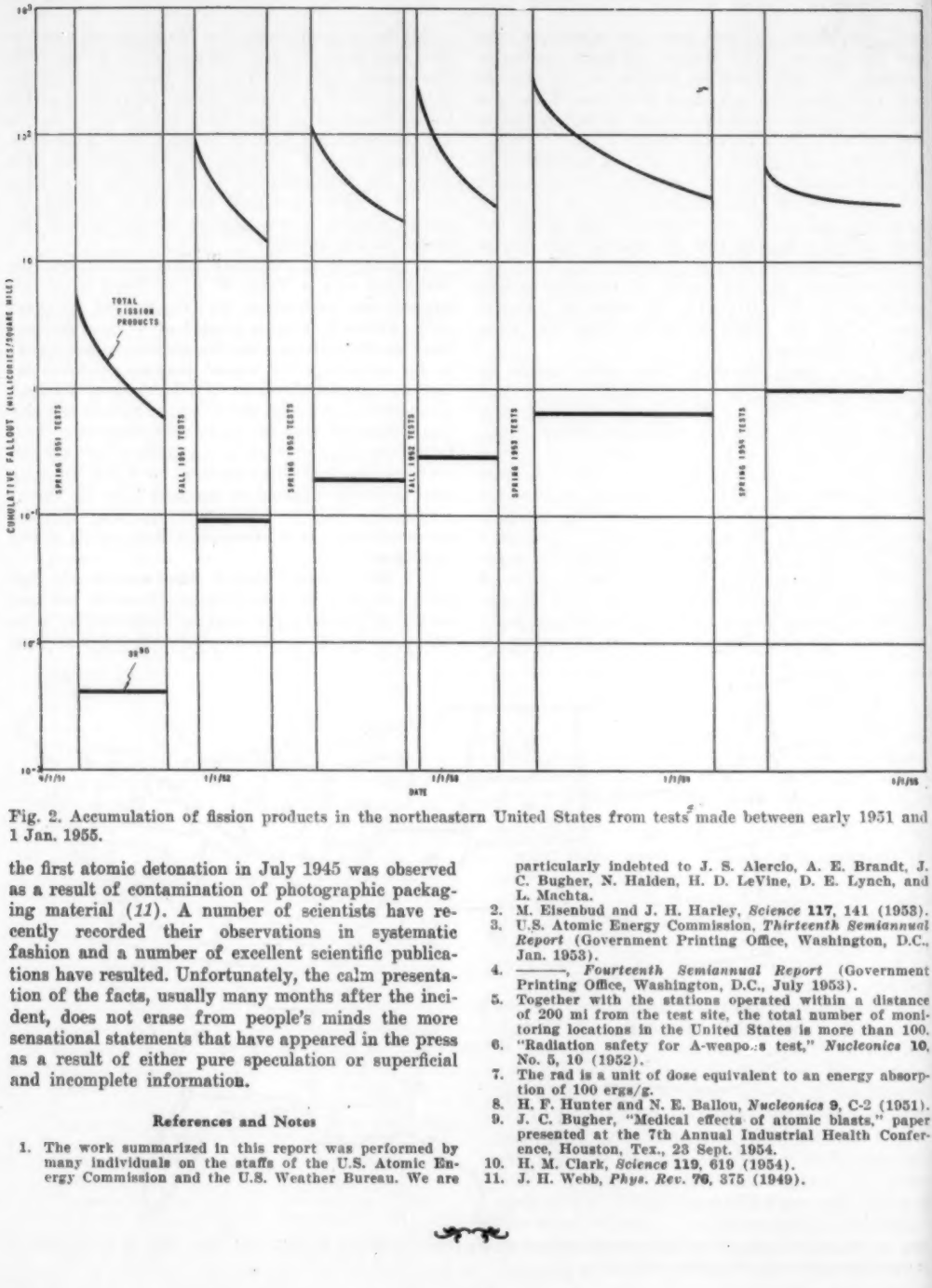

Fig. 2. Accumulation of fission products in the northeastern United States from tests made between early 1951 and 1 Jan. 1955.

the first atomic detonation in July 1945 was observed as a result of contamination of photographic packaging material (*11*). A number of scientists have recently recorded their observations in systematic fashion and a number of excellent scientific publications have resulted. Unfortunately, the calm presentation of the facts, usually many months after the incident, does not erase from people's minds the more sensational statements that have appeared in the press as a result of either pure speculation or superficial and incomplete information.

References and Notes

1. The work summarized in this report was performed by many individuals on the staffs of the U.S. Atomic Energy Commission and the U.S. Weather Bureau. We are particularly indebted to J. S. Alercio, A. E. Brandt, J. C. Bugher, N. Halden, H. D. LeVine, D. E. Lynch, and L. Machta.
2. M. Eisenbud and J. H. Harley, *Science* **117**, 141 (1953).
3. U.S. Atomic Energy Commission, *Thirteenth Semiannual Report* (Government Printing Office, Washington, D.C., Jan. 1953).
4. ———, *Fourteenth Semiannual Report* (Government Printing Office, Washington, D.C., July 1953).
5. Together with the stations operated within a distance of 200 mi from the test site, the total number of monitoring locations in the United States is more than 100.
6. "Radiation safety for A-weapons test," *Nucleonics* **10**, No. 5, 10 (1952).
7. The rad is a unit of dose equivalent to an energy absorption of 100 ergs/g.
8. H. F. Hunter and N. E. Ballou, *Nucleonics* **9**, C-2 (1951).
9. J. C. Bugher, "Medical effects of atomic blasts," paper presented at the 7th Annual Industrial Health Conference, Houston, Tex., 23 Sept. 1954.
10. H. M. Clark, *Science* **119**, 619 (1954).
11. J. H. Webb, *Phys. Rev.* **76**, 375 (1949).

Population Problems

The following two articles—by Alan Gregg and Curt Stern—are based on papers given by the authors in the symposium on "Population problems," held in Berkeley, California, on 28 Dec. 1954, which comprised the second part of the general symposium on Science and Society. *The other two parts of the general symposium were devoted to "Natural resources: power, metals, food" and "Science in human thought and action." Articles based on the papers presented in these sessions will appear in subsequent issues.*

A Medical Aspect of the Population Problem

Alan Gregg
Big Sur, California

THE medical aspects of what is called the population problem defy condensation into a brief paper. Even the relatively few factors we know something about are too numerous and too intricately involved with one another and with external circumstances to lend themselves to summary exposition. For this reason I propose to offer only one idea regarding the population problem. It hardly deserves to be called a medical aspect: it is rather the view of one who has had a medical training—a single idea around which subordinate reflections of a rather general sort present themselves.

In exposing this one idea I recall the Spartan custom of exposing infants to the rigors of the weather, in the conviction that such a practice weeds out the weaklings. To expose an infant idea to the rigors of a scientific atmosphere before providing the poor little thing with the support of experimental evidence or with the power of demonstrated predictive value may seem like Spartan treatment. But if the idea dies of exposure, its exit will be at least more dignified and permanent under AAAS auspices than under any other I could invite or invent. I should therefore witness its death with a very fair semblance of Spartan parental fortitude.

The way in which physicians estimate, by a sampling procedure, the number of white blood cells in the blood of a patient is generally known. In essence, it involves diluting a carefully measured amount of blood in a carefully measured amount of water, counting the number of cells found in a defined cubic volume of the blood thus diluted, and then computing the number of cells per cubic millimeter of blood. A similar method is applied to counting the red cells of the blood. Although such cell counts vary somewhat among individuals and in any one individual under varying conditions of activity, any variation of the order of 400 percent or more would usually justify the suspicion of being pathological. If, for example, a patient's white-cell count moved up within a month from 5000 to 23,000, a physician would think of the possibility that he was witnessing an early stage of leukemia—an uncontrolled growth in the numbers of white blood cells.

Now new growths of any kind (popularly called cancer) involve an increase in the number of some one kind of cell and, hence, a corresponding increase in the size of the organ or tissue involved. However, not all increases in the size of organs are the result of new growths: the heart hypertrophies—that is, grows larger—to make up for leaky valves and its lost efficiency as a pump; the uterus grows in volume remarkably during pregnancy; the organs and tissues of the growing child also present obvious increases in cellular numbers. But in these increases there appears to be a limit at which further cell reduplication stops or is in some way inhibited. Indeed, one has the mystified impression that there is a process involved that in its effect resembles self-restraint or self-limitation. One cannot, of course, attribute a sense of decorum to cells, even though we can give no better answer than ignorance to the question of why organs show a relative uniformity of size and shape in the normal state. But the fact remains that, in all but one instance, organs and tissues in their growth seem to "know" when to stop.

The exception, of course, is the whole category of new growths, or neoplasms (popularly called cancer), of which there are two main sorts—the benign and the malignant. Fibroids of the uterus furnish a good example of benign tumors; cancer of the stomach, of the malignant. I shall return to some of the more important characteristics of new growths, but now I would like, at this point, to introduce another set of considerations more apparently related to the population problem.

If we regard the different forms of plant and animal life in the world as being so closely related to and dependent on one another that they resemble different types of cells in a total organism, then we may, for the sake of a hypothesis, consider the living world as an organism. I would not merely admit that this is a hypothesis—I would insist that it is only a hypothesis. Perhaps more cautiously one would say that such

a hypothesis is no more than a scaffolding. For a scaffolding may serve, but does not enter into, the final structure of established fact.

Let us look, then, at the different forms of life on this planet as a physician regards the federation or community of interdependent organs and tissues that go to make up his patient. What would we think if it became evident that within a very brief period in the history of the world some one type of its forms of life had increased greatly in number and obviously at the expense of other kinds of life? In short, I suggest, as a way of looking at the population problem, that there are some interesting analogies between the growth of the human population of the world and the increase of cells observable in neoplasms. To say that the world has cancer, and that the cancer cell is man, has neither experimental proof nor the validation of predictive accuracy; but I see no reason that instantly forbids such a speculation. If such a concept has any value at the outset, we should quite naturally incline to go further by comparing the other characteristics of new growths with the observable phenomena related to the extraordinary increase now noted in the world's population. An estimated 500 million in A.D. 1500 has grown, in 450 years, to an estimated population of 2 billion today. And the end is not in sight—especially in the Western Hemisphere.

What are some of the characteristics of new growths? One of the simplest is that they commonly exert pressure on adjacent structures and, hence, displace them. New growths within closed cavities, like the skull, exert pressures that kill, because any considerable displacement is impossible. Pressure develops, usually destroying first the function and later the substance of the normal cells thus pressed upon. For a comparison with a closed cavity, think of an island sheltering a unique form of animal life that is hunted to extinction by man. The limited space of the island resembles the cranial cavity whose normal contents cannot escape the murderous invader. Border warfare, mass migrations, and those wars that are described as being the result of population pressures resemble the pressures exerted by new growths. We actually borrow not only the word *pressure* but also the word *invasion* to describe the way in which new growths by direct extension preempt the space occupied by other cells or types of life. The destruction of forests, the annihilation or near extinction of various animals, and the soil erosion consequent to overgrazing illustrate the cancerlike effect that man—in mounting numbers and heedless arrogance—has had on other forms of life on what we call "our" planet.

Metastasis is the word used to describe another phenomenon of malignant growth in which detached neoplastic cells carried by the lymphatics or the blood vessels lodge at a distance from the primary focus or point of origin and proceed to multiply without direct contact with the tissue or organ from which they came. It is actually difficult to avoid using the word *colony* in describing this thing physicians call metastasis. Conversely, to what degree can colonization of the Western Hemisphere be thought of as metastasis of the white race?

Cancerous growths demand food; but, so far as I know, they have never been cured by getting it. Furthermore, although their blood supply is commonly so disordered that persistent bleeding from any body orifice suggests that a new growth is its cause, the organism as a whole often experiences a loss of weight and strength and suggests either poisoning or the existence of an inordinate nutritional demand by neoplastic cells—perhaps both. The analogies can be found in "our plundered planet"—in man's effect on other forms of life. These hardly need elaboration—certainly the ecologists would be prepared to supply examples in plenty of man's inroads upon other forms of life. Our rivers run silt—although we could better think of them as running the telltale blood of cancer.

At the center of a new growth, and apparently partly as a result of its inadequate circulation, necrosis often sets in—the death and liquidation of the cells that have, as it were, dispensed with order and self-control in their passion to reproduce out of all proportion to their usual number in the organism. How nearly the slums of our great cities resemble the necrosis of tumors raises the whimsical query: Which is the more offensive to decency and beauty, slums or the fetid detritus of a growing tumor?

One further analogy deserves attention. The individual cells of new growths often show marked variations of size, shape, and chemical behavior. This may be compared with the marked inequalities of health, wealth, and function so conspicuous among the human beings in overpopulated countries. Possibly man's invention of caste and social stratification may be viewed in part as a device to rationalize and control these same distressing discrepancies of health, wealth, and status that increase as the population increases.

By now the main posts and planks of my scaffolding must be obvious. In the history of science there have been hypotheses that, although not true, have led to truth. I could hope that this somewhat bizarre comment on the population problem may point to a new concept of human self-restraint. Besides ennobling human life, it would, I think, be applauded by most other forms of life—if they had hands to clap with. Or are we deaf to such applause?

And finally, I submit that if some of the more thoughtful cells in, say, a rapidly growing cancer of the stomach could converse with one another, they might, quite possibly, reserve some afternoon to hold what they would call "a discussion of the population problem."

If Copernicus helped astronomy by challenging the geocentric interpretation of the universe, might it not help biology to challenge the anthropocentric interpretation of nature?

Qualitative Aspects of the Population Problem

Curt Stern

Department of Zoology, University of California, Berkeley

THE title of this paper might also have been "A geneticist's comments on the population problem." Although the viewpoint expressed is essentially that of the genetic student of populations, I shall not refrain from giving some opinions and raising some questions that relate to more general aspects of human populations.

Human beings are different from one another. Therefore, changes in the number of people who make up the world's population are likely to involve changes in the proportions of different kinds of people. That such changes have occurred and continue to occur is a matter of record. Thus, Kirk's graphs of world population growth show that in 1650 the people of Asia and Africa were about 4 times as numerous as those of areas settled by Europeans; that in 1950 the ratio had declined to 1.6:1; and that in 1980 it may be expected to rise again to approximately 2:1. Still more obvious are the changes in the proportions of different kinds of people when one considers, not the earth's population as a whole, but the populations of more restricted areas. The change in Tasmania in the ratio of Tasmanians to Europeans from 100:0 to 0:100 percent took place in less than 30 years. In South Africa, within a few centuries, Europeans and Indians grew to considerable proportions of the total number of inhabitants, and all through the ages similar immigrations and colonizations, if not wars of extinction, have changed the qualitative composition of populations. To a lesser degree, such changes very likely have also affected the qualities of the home populations who furnished the emigrating groups. In general, these emigrating groups are not random samples of the populations at their places of origin, but vary from the nonemigrating group in age, sex, health, education, and social status. Obviously, such selective emigration leaves a qualitatively changed group at home.

Qualitative changes occur even within self-contained populations. Short-time variations as well as secular variations in birth and death rates affect the age distributions. Differential fertility of different subgroups, together with social mobility within one generation and the rise and fall of individuals of successive generations in the social hierarchies, all make it impossible for a population to remain static in its composition. Changes in quality of populations usually cannot be measured easily and meaningfully on a scale of values. Diversity rather than uniformity is an essential element of human society, but the right balance between these two relative attributes cannot be defined because of our ignorance of the innumerable factors involved and the complexities of their interactions. Moreover, there must be very many different equilibriums between uniformity and diversity. One is reminded of Sewall Wright's model for the evolution of species that conceives of an infinite number of adaptive peaks in a multidimensional landscape of mountains and valleys of adaptive elevations.

Many of the most significant changes in the qualities of the populations in the world are primarily of cultural nature. The entry of hundreds of millions of Asians and Africans into the technologic areas of Western civilization is bound to change fundamentally the proportion of culturally differently oriented individuals. The end of the cleft between colonizers and colonial dependents, the imminent abolition of illiteracy in the world, the increasing domination exerted on people everywhere by the media of mass communication, and the natural emphasis in the economically underdeveloped countries on material improvement are factors that alter the quality of humanity deeply. Many of the changes should be greeted with enthusiasm. Others may be regretted. Thus, to single out two of the latter, the sudden entrance of millions of Asians and Africans into the cultural heritage of the West is in part accompanied by a loss of their own heritage. And the emphasis on the applied aspects of Western culture that the West itself has experienced may be still more strengthened by newcomers who can easily acquire the technologic skills but only slowly recreate the basic concepts and values.

With regard to changes in the *genetic* constitution of mankind, one might be inclined to say that the changes of which we have knowledge are of minor interest and those that are of major importance are unknown. The changes of which we have knowledge are the external characters of color of skin, hair, and iris, of hair shape, of size, and of anatomical features that distinguish people from one another. They also include such normal differential traits as blood groups and the numerous genetically caused abnormal traits that afflict mankind. It is probably of minor consequence for mankind that the relative number of genes for dark skins will increase again or that the proportion of people with blood group O will decrease. Yet the last word has not been said about the deeper significance of such traits. Thus, it has only recently been shown by English workers that blood-group-O people have a greater likelihood than others to develop peptic ulcers, while group-A persons are somewhat more susceptible to cancer of the stomach. But, however fateful such genetic facts may be for a few individuals, the prospects of populations will not depend on them. Nor will this be true to any appreciable degree with a genetic phenomenon that is the result of the wider choice of mates which the im-

provement of transportation and various other social changes have brought about. Where formerly each national or regional population was actually made up of a multitude of relatively separate subgroups with a strong preference for intragroup mating, a breakup of these semi-isolates has taken place in recent decades.

Now, it is the nature of genetic population phenomena that different isolates come to possess some differences in genic content. One of the few obvious results of such differential content is the variable frequency of hereditary anomalies in different isolates. Group I may have relatively many individuals afflicted with disease *A* and few with disease *B*, while, inversely, group II may rarely be afflicted with disease *A* but more frequently with *B*. With the breakdown of isolation, not only a more equal distribution of diseases *A* and *B* over the whole population will come about, but also, if they are recessive diseases, a considerable reduction in the actual numbers of those afflicted by either disease *A* or disease *B*. Here, then, is a biologic basis for desirable aspects of the intermingling of the genic content of formerly separated groups. In the future, public health statistics are likely to give evidence for this aspect of population changes.

If isolates differ somewhat from one another in their content of clearly undesirable genes, it may be presumed that they also differ in desirable genes. This likely fact is difficult to demonstrate. The genetic causation of amaurotic idiocy is easily established and the negative value of the condition is beyond doubt, but neither the genetic basis nor the social desirability of many other traits are the subjects of general agreement. This is an area where some feel serious concern. Are the different racial groups of mankind equally endowed with creative ability? Do their genetic endowments enable them to create equally well in different spheres? Many sermons have been preached on alternative answers to these questions, but the answers have not been based on solid facts. The histories of human groups are experiments with many unknown variables and no control. A natural scientist who would derive final answers from such data obtained in his laboratory would be rejected by his profession. The part that biologic determinants play in the history of mankind remains unknown. My private supposition is that it is a small part and that the inertia of historical trends in different nations is predominantly culturally conditioned. Each event, however initiated, seems to limit the range of possible further events. Whether or not this view is correct, the future course of human affairs cannot help being influenced decisively by the changes in the quality of the world's populations. Whether or not, for instance, Asian cultures are bound up with genetic differentials of Asian people, their rise in world importance assures a growing influence of their thought and of their social antecedents.

The differential growth of various parts of the whole world's population finds a counterpart within many of the subgroups. For a century at least different socioeconomic segments of the populations of many western countries have shown different rates of reproduction. It is generally known that a negative correlation exists between the educational level of the parents and their rate of reproduction. In recent years the gap between the reproductive rates of the so-called higher and lower socioeconomic groups—a grouping that is closely allied to educational levels—has narrowed considerably. Family planning has become widespread in those groups who, in the past, did not limit their births, and a voluntarily larger number of children are being raised by those other groups who had formerly stringently restricted their reproduction. If one assumes that some of the causes that place an individual in a specific socioeconomic group are genetic, then one may be inclined to conclude that the differential reproduction of these groups should have led to a change in the quality of the population, namely, to a loss of genes involved in certain types of intelligent behavior. This argument always lacked complete cogency since the trend of reproductivity within each group remains relatively unknown, and, thus, the possibility is left open that, within groups, a positive correlation exists between genetic endowment and the number of children. Such a positive hypothetical intragroup correlation would counteract the supposed loss of genes from intergroup differential fertility.

Two new developments have recently been brought to bear on this problem of a possible deterioration of specific elements of the genetic endowment in populations with differential fertility. One involves an observational approach, and the other a conceptual approach. The former is most thoroughly represented by the Scottish survey of the test intelligence of school children conducted in 1932 and in 1947. No decline in the mean test performance had occurred during the interval between the two comprehensive studies. This was contrary to some predictions, but it cannot be adduced as evidence for genetic stability. It is possible that educational and social circumstances during the intervening 15 years would have led to some improvement in the test responses of individuals with identical genotypes, and there is evidence in the data that some changes in the responses did occur. Since the direction and degree of such changes in response cannot be measured accurately, the interpretation of the observed mean scores remains uncertain. They could be evidence either for lack of genetic change or for genetic change compensated by change of response.

The conceptual approach to the problem of differential fertility in relationship to the genetic status of a human population has usually rested on the assumption that differential fertility is a recent anomaly brought about by civilization. Penrose has considered the opposite assumption and has set up a model that would assure constancy of genetic endowment by means of differential fertility. In this model, a superior group is homozygous *AA*, an inferior group is

heterozygous *Aa*, and a third group of infertile weaklings is homozygous *aa*. If it is further postulated that the inferior heterozygotes are much more fertile than the superior homozygotes, an equilibrium will result in which the lower fertility of the superior types will be balanced by the still lower fertility of the weaklings. In a population with such a genetic equilibrium, the mean test score would remain constant from generation to generation. Moreover, if the fertility of the superior group is below its own replacement value, the continued existence of the population would depend on the higher fertility of its inferior component.

The formal success of such a model must give one pause even though it should not be taken too literally. The idea that heterozygosity is an essential property of populations that assures them stability has attractive features and, for some special cases, experimental support. It is, however, not yet known how widely spread this phenomenon is. In particular, it is hardly true that the fertility of the better-endowed layers of a human population is intrinsically insufficient to replace its genic content. Therefore, the physical persistence of populations could at least be equally assured by the increased fertility of its better-endowed members and by the lowered fertility of its less-well-endowed members than by the present method. Moreover, reversal of the present order of fertility would lead to genetic improvement with regard to the traits discussed while, without reversal, at best an equilibrium would be maintained.

It has been argued that, at whatever mean level of performance, a population must, by definition, contain a group of subnormal individuals and that an upbreeding of humanity would never solve the problems posed by the instrinsic spread of any frequency distribution. As far as it goes, the argument has much in its favor, but it hardly justifies a laissez-faire attitude. Evolution has always involved the existence of an inferior tail end in the distribution of fitness, and the statement that "there must always be a tailend" is not an argument against the desirability of wisely directed evolutionary trends.

It is, of course, the basic assumption of the preceding discussion that there *are* genetic differences among different socioeconomic layers within a large population and that these differences are positively correlated with certain values accepted by the society. Endowment for intelligence, although not adequately measured by test scores, is at least partially estimated by them, and its value, although not admitted universally, is taken for granted here.

The more immediate premise of the existence of genetic differentials among social layers is often disputed. Social factors, such as education, wealth, and opportunity, are undoubtedly determinants in social status as well as in intelligence-test performance. Any correlation between status and performance, thus, contains *non*genetic elements. The question remains, however, of whether *genetic* elements are also involved in such a correlation, both as independent agents and in specific interactions with the environment. It seems to many geneticists that this question must be answered affirmatively at least for societies with appreciable social mobility, that is without rigid caste systems. If this is granted, then the large and differential growth of populations in such societies must necessarily result in changes in the quality of these populations. This may be less so in the more permanently stratified societies where this stratification is mainly historically frozen instead of being recreated in successive generations. Although a differential endowment may also exist here, perhaps high social status may as likely be correlated with high genetic endowment as with low genetic endowment. Moreover, in the absence of continuously new stratification of the over-all genic content of the population, it is probable that genetic differentials concerned with social attributes are relatively small. It will be noted that these statements contain many reservations—an indication of the uncertainty of our knowledge and an incitement to further research.

The geneticist cannot doubt that the complex and changing patterns of the reproduction of human populations are of significance for the quality of their genetic endowment. These patterns of reproduction are partly the result of incompletely understood motives and are partly under the control of social forces which themselves are subject to planned manipulation. The danger of any interference in patterns of reproduction is great, but it should not exclude a rational consideration of both the harm and the good that may come from it. Again it must be emphasized that a do-nothing attitude also has its specific consequences, for better or worse.

What then can be done? Little, I believe, in the immediate future. The burst of population growth of which we are witnesses is like the outbreak of an epidemic. All that we can hope at the moment is to keep it in bounds and see that its dangers are minimized. But we must prepare for less stormy times. When an equilibrium between births and deaths is approached again, mankind should be ready to wisely direct its reproductive patterns so that at least a deterioration of the quality of the species is avoided; better still, that it is improved. Men are not cattle, and no one should treat them as such. But must we really, in the long run, renounce the benefits that come from positively selective reproduction, or should we rather learn to devise methods compatible with individual responsibility and voluntary action?

There is no magic in a specific number of inhabitants for a country or for the whole world. Those who fear that our resources will prove inadequate to support the billions of the future at a desirably high level may possibly underestimate man's creative abilities. But it can be said with much greater certainty that the growth of population must stop at some stage. Any generation, therefore, that increases its number does this at the expense of a later generation. If some countries base their economies on a growing population, rather than on a steady population, be-

cause it is easier, they thereby deprive future generations of this advantage. If other countries with low living standards and scarce resources now suffer under the load of population growth, their inability to control their population may make it more difficult to attain the desirable improvements of civilization.

The time may come when population policies will tend toward a reduction of stabilized population sizes. Then the ancient desire of many parents to have at least their own number replaced by their children will have to remain unfulfilled because earlier generations indulged in an irresponsible fertility. The problem of the quality of the future populations will then arise in a more painful form than before since it will mean not only differential restriction but differential renunciation of parenthood. Such renunciation is by no means unknown, witness the history of Ireland's population during the last century.

The quality of human populations is difficult to define and still more difficult to control. This is the reason why considerations of quality have been overshadowed by those of quantity. It can only be hoped that men will not be deceived by awe of mere numbers. In the meantime, biologic and social knowledge will be increased so that it may be applied to the improvement of the world community.

Warder Clyde Allee: Ecologist and Ethologist

THE death of Warder Clyde Allee on 18 March 1955 in Gainesville, Fla., has deprived biology of a leading student of animal ecology and behavior. Since his retirement as professor emeritus of zoology from the University of Chicago in 1950, Dr. Allee had been head of the department of biology at the University of Florida. He was planning to retire from formal academic responsibilities in 1955 and to devote himself to writing and further researches on the social life of animals. Death resulted from an infection, with heart involvement, only 2 days after his admission to the hospital. His health was good in recent years, considering the fact that his legs and lower abdomen were paralyzed as a result of a benign tumor in his spinal cord that developed approximately 25 years ago. In spite of confinement to a wheel-chair, he had continued active teaching, research, and administration, and had accepted many lecture engagements in this country and abroad. He usually spent his summers at the Marine Biological Laboratory, Woods Hole, Mass.; he was a member of the board of trustees of that institution.

Allee was born of Quaker parentage on a farm near Bloomingdale, Ind., on 5 June 1885. He maintained a loyal association with the Society of Friends throughout his life and had a justified pride in the ideals and history of the group, as well as in its international interests and services. He found his scientific and religious convictions entirely compatible.

Allee attended Earlham College, which granted him a bachelor's degree in 1908. He later became a member of the college's board of trustees and received an honorary LL.D., from Earlham, in 1940. He met Marjorie Hill at Earlham and they were married in 1912. They had three children. The first, Warder, was killed in a street accident at the age of eight—a shock from which his parents never wholly recovered. Two daughters, Barbara and Mary, are married and mothers of his grandchildren. Marjorie Hill Allee died in 1945 after having written many fine books for children. She collaborated directly and indirectly in many of her husband's writings. Allee married Ann Silver 2 years ago, a charming person who rapidly became identified with his new career at the University of Florida.

Allee pursued his graduate work in zoology at the University of Chicago, where he received the Ph.D. degree in 1912 under the direction of Victor E. Shelford. He was successively on the teaching staffs of the University of Illinois, Williams College, the University of Oklahoma, and Lake Forest College, before he returned to the University of Chicago in 1921 as assistant professor of zoology. He was professor of zoology at Chicago from 1928 until his retirement in 1950. He directed the doctoral researches of about 38 students during his career, many of whom now fill important academic positions. Allee also taught at the Marine Biological Laboratory during the summers, at the University of California during the winter of 1923, and at the summer school in Logan, Utah, from 1924 to 1926.

He was a member of the National Academy of Sciences and held numerous offices in scientific organizations among which were the vice presidency (Section F) of the American Association for the Advancement of Science in 1942, the presidency of the Ecological Society of America in 1929, and the presidency of the American Society of Zoologists in 1936.

Allee succeeded Charles M. Child as editor of *Physiological Zoology*. Besides being the author of many articles in scientific journals in the fields of physiology, ecology, animal aggregations, behavior, and animal sociology, he was also the author or coauthor of many books, including *Jungle Island, Nature of the World and of Man, Animal Aggregations, Animal Life and Social Growth, The Social Life of Animals, Ecological Animal Geography,* and *Principles of Animal Ecology*. His most notable researches dealt with the analysis of the physical factors in marine, fresh water, and terrestrial environments—both in temperate and tropical climates—and pioneering experiments on aggregating and social be-

havior of invertebrates and vertebrates. He detected a trend in the evolution of animals from "protocooperation" toward well-defined cooperative behavior, and produced much evidence for the antecedents of human social behavior.

Allee's ability to overcome emotional and physical distress and to continue at a sustained level of scientific productivity is an inspiration to his many colleagues and students. He demonstrated responsibility, honesty, self-discipline, and personal integrity to an outstanding degree and has made a lasting contribution to biological science. He has left behind a host of friends who hold him in affectionate regard.

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News and Notes

Western Water

Papers presented at the recent Pacific Southwest regional meeting of the American Geophysical Union emphasized water problems of particular interest in the West. The meeting, held at the University of California, Berkeley, on 4–5 February, was attended by 150 registrants.

A high point of the first day's sessions was a symposium on *Hydrology and Oceanography of San Francisco Bay*. Studies of San Francisco Bay, including tides, currents, salinity intrusion, sediment deposition, and streamflow, have been stimulated by the comprehensive investigation of the California Water Project Authority. This work, initiated by a directive of the state legislature, is concerned with the feasibility and economic value of salinity-control barriers in San Francisco Bay. A report of the investigation will be presented to the legislature in March 1955. Gordon L. Long, in a paper entitled "Geophysical considerations of salinity control barriers in San Francisco Bay," reported on the engineering studies for the investigation. He emphasized the delicate balance and complex interrelation of tides, streamflow, and sediments in the Bay and how these geophysical elements would effect the functional feasibility of a barrier. In a paper by Dean C. Muckel and Harry F. Blaney, studies were described of probable evaporation and evapotranspiration losses that would occur from free-water pools if salt-water barriers were constructed in San Francisco Bay. Based on climatological records and new measurements, annual and monthly estimates of evaporation from lake surfaces and of consumptive use by marsh vegetation were prepared for critical water-supply years.

The hydraulics of San Francisco Bay defy direct analytic solution, thereby requiring other approaches to the problem. "A proposed model study of San Francisco Bay" by John A. Stirton told of a proposed comprehensive hydraulic model to be constructed by the Corps of Engineers, U.S. Army, in an attempt to obtain solutions for numerous hydrographic, sediment, and navigation problems of the Bay. Prototype data needed for the construction, verification, and operation of the model were described. The final paper of the symposium was by Robert E. Glover, "A new method for predicting transient states of salinity intrusion into the Sacramento-San Joaquin Delta." A mathematical analysis indicated the flows required through the delta to hold salinities penetrating upstream from San Francisco Bay to specified amounts. Results compared favorably with data from independent studies.

In a session of the hydrology section, J. F. Poland and G. H. Davis presented "Subsidence of land surface in the Delano and Mendota-Huron areas, San Joaquin Valley, California." This paper told of subsidence that now exceeds 10 ft in two areas of the San Joaquin Valley. Annual rates vary between ½ and 1 ft/yr. Plots of subsidence against decline in artesian pressure suggest that the extensive ground-water pumpage in the areas is a major cause of the subsidence. Studies of organic, inorganic, and radioactive tracers were described by W. J. Kaufman and G. T. Orlob in "An evaluation of ground-water tracers." Using lysimeter columns containing three California soils, inherent weaknesses in certain radioactive isotopes were indicated because of soil adsorption. Also mentioned were field studies of a radioiodine tracer in a recharge well surrounded by observation wells. Other papers of the session dealt with the mechanics of overland flow, hydrology of the San Bernardino and Eastern San Gabriel mountains of California, geology and water quality relationships in two northern California areas, and spring sapping of certain submarine canyons of the California coast.

The session of the oceanography section featured a series of papers reporting extensive research on waves. C. L. Bretschneider described analyses of the generation of wind waves over a continental shelf, Oswald Sibul told of laboratory studies of wind tides in shallow water with varying bottom conditions, and M. Manohar reported on experimental and analytic work on the effect of wave action on bottom sediments. Other papers included a report on a model study of wave action on a cylindrical island by A. D. K. Laird and an investigation of wind-generated short-crested waves using a ripple tank by G. C. Ralls, Jr.

On the second day of the meeting a symposium on *Snow and Watershed Management* was held. Several aspects of the importance of snow in California were discussed. Fred A. Strauss described the dependence of California's water supply on the spring snowpack, while Walter J. Parsons pointed out the menace of

snow-melt floods. In an interesting paper, "Operation wet blanket: proposed research in snowpack management in California," Edward A. Colman stated that the accumulation and melt of snow may be partially controlled by employing proper forest planting and cutting. Emphasizing that work in other areas may not apply in California because of different weather and forest conditions, he proposed various field and pilot tests of forest lands for improved water yield as well as for timber production. As a corollary to the previous paper, Henry W. Anderson, in "Forest effects on snow-pack accumulation and melt, Central Sierra Snow Laboratory," indicated that snowpack accumulation and melt at a given point were related to the amount of forest shade and to the height and distance of the trees from the snow-measurement point.

DAVID K. TODD

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AAAS—Rosenthal Award for Cancer Research

The American Association for the Advancement of Science announces that, beginning this year, it will award annually the AAAS–Anne Frankel Rosenthal Memorial Award for Cancer Research. The award is supported by the Richard and Hinda Rosenthal Foundation and consists of $1000. It will be given once each year for at least 5 years for outstanding research by a scientist resident in the United States. In proposing the award, the foundation stated:

> We do not wish to exclude an outstanding advance on the more applied, or even clinical, level, but we do wish to make it quite clear that very basic pieces of research would surely qualify for primary consideration.

The board of directors of the Association has named Warren Weaver as chairman of the award committee and has invited the American Cancer Society, the National Cancer Institute, the Sloan-Kettering Institute, and the American Association for Cancer Research each to nominate one member of the committee. Richard L. Rosenthal, president of the Richard and Hinda Rosenthal Foundation, will also serve as a member of the committee. Each year this committee will nominate a recipient prior to the Association's annual meeting during the last week in December. The nomination will be formally submitted for approval by the board of directors of the Association and will be announced at the annual meeting.

The first award will be announced in December 1955 and will be for work that was completed or reported to the scientific world sometime during 1954 or 1955. Later awards will be for work completed or reported subsequent to the last previous work that received the prize.

The committee, using suggestions received from its own membership and from whatever proposals it may see fit to solicit, will consider only work that has been reasonably fully reported to the scientific community through the usual oral or printed channels, so that the work will have been subject to the usual processes of general scientific judgment regarding its validity and importance.

Science News

The **National Academy of Sciences** at its 92nd annual meeting in Washington, D.C., elected a home secretary, 3 members of the council, 30 members, and 4 foreign associates. Hugh L. Dryden, director of the National Advisory Committee for Aeronautics, Washington, D.C., was elected home secretary for a 4-year term, beginning 1 July. He succeeds Alexander Wetmore, research associate, Smithsonian Institution, Washington, D.C. Other officers of the academy, all of whom are members of the council, are pres., Detlev W. Bronk; v. pres., George W. Corner; foreign sec., John Gamble Kirkwood; treas., William J. Robbins.

E. A. Doisy of the St. Louis University School of Medicine, Theophilus S. Painter of the University of Texas, and James Gilluly of the U.S. Geological Survey, Denver, Colo., were elected to the council. Doisy and Painter will serve 3-year terms beginning 1 July, and Gilluly will complete Dryden's unexpired term which terminates 30 June 1956. Additional members of the council at the present time are Farrington Daniels, Robert F. Loeb, Wendell M. Stanley, Merle A. Tuve, and Edwin B. Wilson. Loeb and Stanley complete their terms on 30 June.

Newly elected members of the academy are as follows:

William Foxwell Albright, professor of Semitic languages, Johns Hopkins University.

Lawrence Rogers Blinks, professor of biology, Stanford University, and director, Hopkins Marine Station, Pacific Grove, Calif.

Richard Dagobert Brauer, professor of mathematics, Harvard University.

Harrison Scott Brown, professor of geochemistry, California Institute of Technology.

Robert Kyle Burns, staff member, Carnegie Institution of Washington, Baltimore, Md.

Subrahmanyan Chandrasekhar, professor of theoretical astrophysics, Yerkes Observatory, University of Chicago, Williams Bay, Wis.

John Chipman, professor of metallurgy, Massachusetts Institute of Technology.

Carleton Stevens Coon, curator of ethnology, University Museum, University of Pennsylvania.

Richard Courant, professor of mathematics and director, Institute of Mathematical Science, New York University.

Gilbert Dalldorf, director, Division of Laboratories and Research, New York State Department of Health, Albany.

Paul Hugh Emmett, senior fellow, Mellon Institute, Pittsburgh, Pa.

Ralph Waldo Gerard, professor of neurophysiology, Neuropsychiatric Institute, University of Illinois, Chicago.

Kurt Gödel, professor of mathematics, Institute for Advanced Study, Princeton, N.J.

Raymond George Herb, professor of physics, University of Wisconsin.

Johannes Holtfreter, professor of zoology, University of Rochester.

Marion King Hubbert, research geologist, Shell Oil Co., Houston, Tex.

Nelson Jordan Leonard, professor of chemistry, University of Illinois, Urbana.

Colin M. MacLeod, professor of microbiology, New York University College of Medicine.

Horace Winchell Magoun, professor of anatomy, University of California Medical Center, Los Angeles.

Deane Montgomery, professor of mathematics, Institute for Advanced Study, Princeton, N.J.

Philip McCord Morse, professor of physics, Massachusetts Institute of Technology.

John Robinson Pierce, director of electronics research, Bell Telephone Laboratories, Inc., Murray Hill, N.J.

Charles Phelps Smyth, professor of chemistry, Princeton University.

Esmond Emerson Snell, professor of chemistry, University of Texas.

Kenneth Wartinbee Spence, professor of psychology, State University of Iowa.

George Eugene Uhlenbeck, professor of theoretical physics, University of Michigan.

Robley Cook Williams, professor of biophysics and biophysicist to the Virus Laboratory, University of California, Berkeley.

David Wright Wilson, professor of physiological chemistry, School of Medicine, University of Pennsylvania.

Perry William Wilson, professor of bacteriology, University of Wisconsin.

Saul Winstein, professor of chemistry, University of California, Los Angeles.

The following new foreign associates were announced:

Max Born, formerly professor of physics at the University of Göttingen, now retired, Bad Pyrmont, Germany.

Bertil Lindblad, director, Stockholm Observatory, Stockholm, Sweden.

André Lwoff, head of the department of microbial physiology, Institut Pasteur, Paris, France.

Sir Alexander Todd, professor of chemistry, Cambridge University, Cambridge, England.

The seaweed kelp has furnished the basic material for synthesis of a new chemical to keep blood from clotting. The **new anticoagulant,** which is nonpoisonous in large doses and acts for the required length of time, is being developed at the Canadian National Research Council's Maritime Regional Laboratory in Halifax, N.S., Canada.

The success of the Salk vaccine has prompted President Eisenhower to suggest that the **first award for Distinguished Civilian Achievement** be made to Jonas Salk, developer of the vaccine.

On 22 Apr. Salk received from the President at the White House a presidential citation; the other award awaits Congressional approval. In this connection a Washington Post editorial says in part:

> It is a happy thought that the first of the proposed Awards for Distinguished Civilian Achievement should go to Dr. Jonas Salk, who has developed the polio vaccine. There is not likely to be any dissent from President Eisenhower's suggestion that Dr. Salk has earned this extraordinary recognition for the service he has rendered to mankind. Indeed, the indication that the President has Dr. Salk in mind as the first recipient of the award he asked Congress last January to create should hasten enactment of the necessary legislation. There is no good reason to confine high honors from the Government to the military field. An achievement such as Dr. Salk's may be even more important to the welfare of the people and to the life of the Nation than the winning of a battle. Congress cannot act too promptly in creating the award that the President wishes to confer.

Social isolation cannot be cited as a crucial, predisposing element in the development of **schizophrenia,** according to a study conducted by the Laboratory of Socio-Environmental Studies of the National Institute of Mental Health. The study, under the direction of John A. Clausen and Melvin L. Kohn, was concerned with the relationship between the effects of social isolation on an individual and the subsequent development of schizophrenia. It was carried out at Hagerstown, Md., over a 2-year period.

Although the investigators found a large amount of social isolation during adolescence among schizophrenics, isolation in itself did not appear to be the predisposing factor nor did it seem to intensify the severity of the disease. Isolation from other people appears to be important only after development of the abnormal personality is well advanced and the individual has already shown signs of a feeling of inadequacy in his dealings with other people.

In a study of 500 **inscribed rocks in the Negev,** the southern desert of Israel, Emmanuel Anati, archeologist with the Israel Department of Antiquities, and other scientists have distinguished 7 styles of art representing as many different eras. The most ancient has been tentatively assigned to the Stone Age. Anati's account of the petroglyphs is scheduled for publication in the spring issue of *Archaeology.* Almost all the desert regions—from Algeria in the west to Eastern Arabia and Mesopotamia in the east—bear traces of rock pictures, but the importance of the Negev finds lies in their continuity, which affords scholars a clear historical outline of the region. An accidental discovery of some ancient rock inscriptions by the Hebrew University's department of geography started Anati on a trail through the desert that culminated in his study.

Scientists at the U.S. Department of Agriculture have succeeded in immunizing chickens against the cancerous disease **visceral lymphomatosis,** also known as big-liver disease. Resistance to the disease was passed from vaccinated hens to their chicks through the eggs in experiments conducted at the Regional Poultry Research Laboratory, East Lansing, Mich. These results follow closely another development at the East Lansing laboratory, a diagnostic technique that may prove important in the identification of the visceral form of lymphomatosis.

To immunize the chicks, B. R. Burmester and associates vaccinated hens with a dilute preparation of the visceral-lymphomatosis virus made from diseased chicken livers. Burmester thinks that vaccination resulted in a buildup of protective antibodies; apparently these were passed through the eggs to the chicks. The East Lansing studies used White Leghorn hens of a highly susceptible strain. It has been estimated that lymphomatosis costs the poultry industry $50 million annually.

The Los Angeles County Museum has recently acquired the **Georg Statz collection of fossils** of the Tertiary of Germany. This collection consists of more than 6000 specimens, including approximately 700 types and illustrated specimens, in an excellent state of preservation. Insects predominate in the collection, but many plants, as well as a few vertebrates and fresh water shells, are included. The material, which was collected in Oligocene fresh water deposits near Rott, Germany, represents 30 years of diligent collecting and research undertaken by the late Georg Statz through the facilities of the University of Cologne. Statz previously exhibited the curated material in Berlin in 167 glass-topped cases. These cases are intact and have the original identification labels, drawings, and photographs systematically associated with the fossil specimens. After its preliminary presentation from 25 May to 26 June, the collection will be established in a permanent exhibit.

The council of the **European Organization for Nuclear Research** (CERN) has passed the following resolution concerning its membership policy:

> According to Article III of the Convention, States not yet members of the Organization can apply for membership. During the period of the building up of the Organization the Council considers it advisable to defer action on such applications until January 1957. However, the Council authorizes the Director-General to accept, prior to that date, subject to approval by Council and on appropriate terms, suitable research workers from non-Member Countries as collaborators in the work of CERN.

One of the last gaps in the midde of the list of radioactive forms of common metals has been filled by the identification of manganese 53. Found in a sample of chromium bombarded by protons, the necessary timing studies to establish the half-life of 140 years for the **new isotope** were carried on by Joseph R. Wilkinson of Florida State University, Tallahassee, who is working with Raymond K. Sheline, associate professor of chemistry.

More than 2½ years have been spent measuring the half-life. Theory had predicted a long-lived form of manganese for this particular place in the list of isotopes; in their work, Wilkinson and Sheline had to make certain that no short-lived radioactivity was present in the irradiated sample to confuse the results. The new isotope could be used to follow changes in iron that contains manganese, changes resulting from wear or from shifts in crystalline structure caused by age.

Mervin Moskowitz of Purdue University has described in the 2 Apr. issue of *Nature* a potential **new danger in blood transfusions** if a way is found to keep blood for 2 or 3 mo longer than is now possible. Red blood cells that have been preserved are changed so that they will sensitize a person to his own stored red cells.

During the recent annual meeting of the American Association of Anatomists at Jefferson Medical College, B. Vincent Hall of the University of Illinois confirmed a long-discredited description of the important blood vessels in the kidney. He exhibited photographic evidence that the specialized **capillaries of the kidney** are exactly as described and sketched 100 years ago by William Bowman, the great English physician. Studies of the glomerulus showed branching networks that resemble the capillaries that are elsewhere in the body instead of the simple loop formations more recently assumed.

Scientists in the News

The National Academy of Sciences presented the following awards during its 92nd annual meeting which took place 25–27 Apr. in Washington, D.C.

The Alexander Agassiz medal, established to honor outstanding contributors to the science of oceanography throughout the world, was awarded to **W. Maurice Ewing,** director of the Lamont Geological Observatory and professor of geology at Columbia University, for his work in marine geophysics. Ewing, who is a member of the academy, worked during the war on underwater explosives as well as on the development of a system of long-range underwater sound transmission. Recently he has made particularly important contributions to knowledge of the structure of the floor of the Atlantic Ocean and the continental shelf; his underwater photographic techniques have greatly increased knowledge of conditions on the ocean floor in deep water.

The Elliot medal, awarded for the most meritorious work published each year in zoology or paleontology, was presented to **Libbie H. Hyman,** research associate at the American Museum of Natural History, New York. Hyman's work cited in the award was published in two volumes that appeared in 1951 as parts of a comprehensive treatise, *The Invertebrates.* These volumes are of major importance not only to those

in the technical zoological field, but also to teachers and to research workers concerned with medical matters, especially because many of the organisms treated are parasitic on other animals, including man. Hyman is the first woman to receive this award since it was established in 1917, and she is the second woman to be honored by the academy through presentation of one of its medals.

The J. Lawrence Smith medal was awarded for "fruitful research in meteoric bodies" to **Peter Mackenzie Millman,** head of the section on upper-atmosphere research of the Division of Radio and Electrical Engineering, National Research Council of Canada. Millman pioneered in the application of radar detection techniques to observation of meteor showers, making possible continuous registration of the number and velocity of meteors entering the upper atmosphere regardless of weather or daylight, and including those too small to be observed visually. Millman's earlier work on the spectra of incandescent meteors contributed much to knowledge of the earth's atmosphere.

The Kimber Genetics award, presented for the first time this year, has been established by the Kimber Farms Foundation of Niles, Calif., to recognize distinguished scientific contributions in genetics, either through single accomplishments of unusual significance or through a long period of significant productivity. Two awards were made: to **William E. Castle,** emeritus professor of genetics at Harvard University and now research consultant to the University of California, and to **Hermann J. Muller,** professor of zoology at Indiana University. Both men are members of the academy.

Castle, who is 87, is regarded as the founder of mammalian genetics in the United States. Near the turn of the century his research showed decisively the role of genes as the mechanisms by which inherited characteristics are transmitted. His long career has been unusually fruitful, both as a teacher of the leading mammalian geneticists in the United States today and as a contributor to the science of genetics. Castle was presented the award *in absentia.*

Among Muller's most important contributions have been his studies of the genetic effects of radiations. His work has shed much light on the structure and function of the chromosomes. Muller was awarded the Nobel prize in physiology and medicine in 1946 in recognition of his research.

The Kimber award is made by the National Academy of Sciences upon recommendation of a selection committee that includes three members named by the academy, one named by the Genetics Society of America, and one named by the AAAS.

On 1 May **Brig. Gen. K. E. Fields,** succeeded Maj. Gen. K. D. Nichols, USA (ret.), as general manager of the Atomic Energy Commission. For the past 10 years, with the exception of 2 years on other tours of duty, Fields has been associated with the U.S. atomic energy program.

George W. Rawson has announced his retirement from the research department of Ciba Pharmaceutical Products, Inc., Summit, N.J. After completing his early education in England, his native land, he emigrated to the United States. He graduated in 1916 from the U.S. College of Veterinary Surgeons, Washington, D.C., and then established a general veterinary practice in Fredericksburg, Va. Next he served briefly as a veterinary inspector for the U.S. Bureau of Animal Husbandry. This work was interrupted by 18 mo of war service as an officer in Veterinary Reserve Corps of the U.S. Army, after which he returned to his previous employment. He was stationed in Norfolk, Va., where he specialized in hog cholera, and later he was transferred to Louisiana to help with the control of Texas fever ticks. Then he resigned from Government service to accept appointment as veterinary inspector for the Virginia State Livestock Sanitary Board, in which position he directed his attention to the eradication of bovine tuberculosis.

In 1922 Rawson decided to do some postgraduate work at the School of Hygiene and Public Health, Johns Hopkins University. The following year he joined Parke, Davis and Co., Detroit, Mich., where he served for 23 yr, first as assistant manager in the animal husbandry department and then as head of parasitology in the research department. At Ciba he has spent 6 yr as director of veterinary clinical research and 9 yr (inclusive) as director of parasitology, research department. In the course of his career Rawson has published some 35 technical papers, chiefly on taxonomic and medical entomology, veterinary science, and parasitology. By avocation, he has always been a naturalist, an interest he now hopes to be able to develop more fully.

Karl Spencer Lashley, who first demonstrated a measurable relationship between brain mass and learning ability, will retire this summer as research professor of neuropsychology at Harvard University. Since 1942 Lashley has been director of the Yerkes Laboratories of Primate Biology at Orange Park, Fla., which is operated as a research center under joint sponsorship of Harvard and Yale universities. Lashley's basic interest has been in the neurological and physiological mechanisms that underlie behavior, and his theoretical consideration of the nature of consciousness in relation to the brain and behavior has influenced a generation of psychologists. His demonstration of the relationship of brain mass and learning is regarded as a turning point in modern physiological psychology.

At the Yerkes Laboratories Lashley has directed studies of brain function and structure. This research has included analyses of the sensory connections of the brain and of the microscopic structure of the cerebral cortex. A number of investigations of the "associative areas" that lie between the sensory and motor regions of the cerebral cortex have disproved the theory that these are the "storehouses of memories"

and have shown that, within such areas, any part can carry out the functions of the whole, although at a lower level of efficiency. Other projects have dealt with the function of the long nerve tracts connecting different parts of the cortex, with the effects of different types of cerebral injuries, and with the course and nature of recovery from brain injuries.

Lashley was born at Davis, W. Va., in 1890. He received his A.B. degree in zoology from West Virginia University in 1910; the M.S. in bacteriology at the University of Pittsburgh in 1911; and the Ph.D. in genetics from Johns Hopkins University in 1914. He spent the three following years in postdoctoral study at Johns Hopkins as Bruce fellow in zoology and Johnston scholar in psychology. Lashley started his professional career in 1917 as instructor in psychology at the University of Minnesota, where he was promoted to professor in 1924. In 1920–21 he served as investigator under the U.S. Interdepartmental Social Hygiene Board, carrying out one of the first studies of the educational value of motion pictures. In the summers of 1925 and 1926 he was acting professor of psychology at the University of Chicago and at Columbia University. From 1927 to 1929 he was research psychologist with the Behavior Research Fund of the Institute for Juvenile Research in Chicago. He was then appointed professor of psychology at the University of Chicago, serving until 1935, when he joined the Harvard faculty as professor of psychology; he was named research professor of neuropsychology in 1937.

Among the honors awarded Lashley have been the Howard Crosby Warren medal of the Society of Experimental Psychology, 1937; the Daniel Giraud Elliott medal of the National Academy of Sciences, 1943; and the William Baly medal, Royal College of Physicians, 1953. His memberships include the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences. He has served as president of both the American Psychological Association and the Society of American Naturalists, and he is an honorary member of the New York Academy of Sciences, the British Association for the Study of Animal Behavior, and the American Neurological Association. He is also a foreign member of the British Psychological Association and of the Royal Society of London.

Lashley has served as associate editor of the *Journal of Genetic Psychology, Genetic Psychology Monographs, Journal of Psychology, Acta Psychologica, Journal of Comparative and Physiological Psychology, Quarterly Review of Biology,* and *Journal of the Philosophy of Science.* He is the author of *Brain Mechanisms and Intelligence* and of more than 100 monographs and major articles.

Marshall G. Holloway, a physicist at Los Alamos Scientific Laboratory since 1943, has been appointed director of the Lincoln Laboratory of Massachusetts Institute of Technology. This laboratory, which is concerned with problems of continental defense, is managed by M.I.T. for the Army, Navy, and Air Force. Holloway assumes his new duties this month, succeeding **Albert G. Hill,** who has asked to be relieved of the director's responsibilities to permit him to return to his position as a professor in the department of physics at the institute.

At the spring alumni reunion dinner of the Philadelphia College of Pharmacy and Science on 21 May, two graduates of the institution will receive alumni awards: **E. Fullerton Cook,** professor emeritus of operative pharmacy at the college and senior editor of *Remington's Practice of Pharmacy*; and **Eli Lilly,** chairman of the board of Eli Lilly and Co., Indianapolis, Ind.

Rear Admiral Hyman G. Rickover, pioneer in the development of the nuclear-powered submarine U.S.S. *Nautilus,* has received the 1955 Egleston medal, Columbia University's highest alumni award for "distinguished engineering achievement."

Ruben F. Mettler, electrical engineer and former special consultant to the Department of Defense, has joined the Ramo-Wooldridge Corp., Los Angeles, Calif. Mettler, whose experience also includes 6 years with Hughes Aircraft Research and Development Laboratories, will occupy a position in the guided missile and electronic systems activities of Ramo-Wooldridge.

New trustees of Biological Abstracts, Inc., are **William H. Cook** of the National Research Council of Canada and **Hiram J. Evans** of Syracuse University.

Robert B. Curry, specialist in finance and administration in research and assistant director of the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md., has resigned to take a position as assistant comptroller of the Southern Railway System. Curry, whose office will be in Washington, D.C., will continue to be a consultant to the laboratory. He joined the Hopkins unit in 1946, and was responsible for planning the entire fiscal program for erection of its new $2 million building.

John F. Haines, formerly vice president and chief engineer of the McCauley Industrial Corp. of Dayton, Ohio, has joined the American Locomotive Co. in Schenectady as chief development engineer, atomic products.

Philip B. Price, professor and chairman of the department of surgery at the University of Utah, has been appointed acting dean of the College of Medicine. He will fill the post left vacant by John Z. Bowers who will assume the deanship at the University of Wisconsin Medical School.

Three visiting mathematicians will be in residence at the University of Chicago for the mathematics department's summer program: **H. L. Hamburger** of the University of Cologne; **John Wermer** of Brown University; and **George W. Mackey** of Harvard Univer-

sity. **Alexander Grothendieck** of the University of Kansas will also be present for the first part of the summer.

The following appointments to assistant professor, effective 1 July, have been announced by Massachusetts Institute of Technology: **Carl W. Garland**, chemistry; **Frederick D. Greene, II**, chemistry; **Herbert O. House**, chemistry; **Norman A. Nelson**, chemistry; **John S. Waugh**, chemistry; **John F. Twigg**, graphics; **Earle H. Watts**, graphics; **Robert E. Ogilvie**, metallurgy; **John G. King**, physics.

Carl J. Holcomb, formerly in charge of forest management research at the Mountain State Research Center in Elkins, W. V., a branch of the Northeastern Forest Experiment Station, U.S. Forest Service, has recently been appointed state extension forester of Virginia, with headquarters at Blacksburg.

Stanley S. Wedberg, associate professor of bacteriology at the University of Connecticut, will succeed **Walter L. Kulp** as head of the university's bacteriology department on the latter's retirement next fall. Wedberg is the author of a textbook in basic microbiology and of a number of articles on insect microbiology.

Meetings

Two **seminars on the teaching of preventive medicine** are being organized by the Pan American Sanitary Bureau, Regional Office of the World Health Organization, to include participation by all the 75 medical schools in Latin America. With the current trend of increasing emphasis on prevention, medical and school authorities feel strongly the need for improvement and strengthening of the teaching of preventive medicine in the Americas. The decision to hold the seminars has been stimulated by proposals that have come to the bureau from a number of the medical schools in Latin America. The general purpose of the seminars is to promote the interchange of ideas and experience among deans and professors of preventive medicine in the training of doctors.

The first seminar, planned for the end of August 1955, will include medical-school representatives from Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, Uruguay, and Venezuela. The second, to be held early in 1956, will include representatives from Colombia, Cuba, Dominican Republic, Equador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, and Panama.

In addition to the regular staff of the bureau, two special consultants have been appointed to assist in the preparation of the seminars and to participate in them. The consultants are Abraham Horwitz, subdirector of the National Health Service of Chile and director, on leave of absence, of the School of Public Health of the University of Chile; and Guillermo Arbona, professor and head of the department of preventive medicine in the University of San Juan, Puerto Rico. Horwitz is now visiting the leading schools of medicine in South America to discuss plans for the first seminar. Later in the year Arbona will visit the medical schools in the countries invited to attend the second seminar.

The seminars will be organized in small groups, and there will be no presentation of formal papers. The subjects to be discussed are (i) program and methods of teaching preventive medicine; (ii) organization of the department of preventive medicine—the formation and functions of the faculty; (iii) relationships with other departments of the school of medicine; and (iv) role of the department of preventive medicine in the activities of public health services, and vice-versa.

The 1955 **National Telemetering Conference** will be held 18–20 May in the Morrison Hotel, Chicago. Sponsors are the American Institute of Electrical Engineers, the Institute of Aeronautical Sciences, the Institute of Radio Engineers and the Instrument Society of America. Sessions are scheduled on industrial telemetering, pickups and transducers, flight testing, multiplex techniques, new developments in telemetry, and remote controls and data processing.

At the annual banquet Hugh L. Dryden, director of the National Advisory Committee on Aeronautics, will speak on "Problems in ultra high speed flight." A luncheon talk will be delivered by William A. Wildhack of the National Bureau of Standards. Conrad H. Hoeppner, of Stavid Engineering, Inc., Plainfield, N.J., is the program chairman, and Gilbert H. Brittain, of Armour Research Foundation, Chicago, is the chairman of exhibits.

A Symposium on Reproduction and Infertility, sponsored jointly by the Michigan State College School of Veterinary Medicine and the Michigan Agricultural Experiment Station, will be held at the Kellogg Center for Continuing Education on the college campus, 27–29 June. Major objectives of the symposium will be the review and evaluation of recent progress in the field of reproduction, together with discussion of problems requiring further study.

The first day's session will be devoted to problems of diagnosis of reproductive diseases and a survey of progress in the specific disease areas of vibriosis, leptospirosis, trichomoniasis, and brucellosis. On the second day a series of five lectures will be presented on various aspects of the physiology and anatomy of male and female reproductive processes; in the evening a panel discussion will be held on ova transplantation. The final session will be devoted to papers on the endocrine control of reproduction in the male. The program has been scheduled to allow ample time for questions and discussion after each formal paper.

This is one of ten academic symposiums to be held at Michigan State College in observance of its centennial. Arrangements have been made at the Kellogg Center for lodging and meals for out-of-town guests. Printed programs will be available about 15 May. They may be obtained by writing to E. P. Reineke, Symposium Chairman, Dept. of Physiology and Pharmacology, Michigan State College.

A conference on **The Computing Laboratory in the University** will be held at the University of Wisconsin 17–19 Aug. Specialists in all of the research fields in which the electronic computer can be used will discuss applications of computing equipment. The conference is designed primarily to assess the value of the existing university programs as aids to schools and organizations planning to install numerical analysis laboratories. It will be of interest to educational administrators and to persons in government and industry who are concerned with the use of trained mathematicians in the computing field.

Preston C. Hammer, who heads Wisconsin's computing laboratory, is chairman of conference arrangements. The keynote address will be presented by Conrad A. Elvehjem, dean of the university's graduate school. Other participants are John H. Curtiss, executive director of the American Mathematics Society; Jay W. Forrester, chief of the Digital Computing Laboratory at Massachusetts Institute of Technology; and Philip Thompson, major, USAF, head of the numerical weather prediction unit of the Department of Defense.

Panel discussions and leaders will be as follows: "Future demand for educated personnel," E. K. Ritter of the Naval Proving Grounds Computing Laboratory, Dahlgren, Va.; "Curricular needs," C. W. Adams of the Digital Computing Laboratory, M.I.T.; "Equipping a laboratory," J. W. Carr, III, of the Engineering Research Institute at the University of Michigan; and "Organization and financing of university laboratories," P. Nash of the digital computer laboratory at the University of Illinois. Many other participants will give short talks on special applications of the numerical analysis equipment with which they are most familiar.

Society Elections

South Carolina Academy of Science: pres., G. M. Armstrong, Clemson College; v. pres., I. S. H. Metcalf, The Citadel; sec.-treas., Harry W. Freeman, University of South Carolina; editor, Roberta Lovelace, University of South Carolina; curator, Willard A. Whitesell, University of South Carolina. Councilors are Louis G. Williams, Furman University; T. D. Brown, Erskine College; and W. R. Leonard, Wofford College. The representative to the AAAS Council is Martin D. Young, U.S. Public Health Service, P. O. Box 717, Columbia, S.C.

American Oil Chemists' Society: pres., W. A. Peterson, Colgate-Palmolive Co., Jersey City, N.J.; v. pres., T. H. Hopper, Southern Regional Research Laboratory, USDA, New Orleans, La.; sec., R. W. Bates, Armour and Co., Chicago; treas., A. F. Kapecki, Wurster and Sanger Inc., of Chicago.

American Institute of Mining and Metallurgical Engineers: pres., H. DeWitt Smith, Newmont Mining Corp., New York; sec., E. O. Kirkendall, A.I.M.E., 29 W. 39 St., New York 18; treas., Gail F. Moulton, Rockefeller Bros. The vice presidents are T. B. Counselman, Behre, Dolbear and Co.; Walter A. Dean, Alcoa; Harold Decker, Houston Oil Co. of Texas; Lloyd E. Elkins, Stanolind Oil and Gas Co.; A. B. Kinzel, Union Carbide and Carbon Corp.; and W. W. Mein, Jr., Calaveras Cement Co. Representatives to the AAAS Council are O. B. J. Fraser, International Nickel Co., and James T. MacKenzie, American Cast Iron Pipe Co.

Aero Medical Association: pres., Kenneth E. Dowd, Trans-Canada Air Lines, Montreal; pres.-elect, Jan H. Tillisch, Mayo Foundation, University of Minnesota, and Northwest Airlines; sec.-treas., Thomas H. Sutherland, Marion, Ohio; editor of *Journal of Aviation Medicine,* Robert J. Benford. The first vice president, to become president-elect next year, is Capt. Ashton Graybiel, U.S. Naval School of Aviation Medicine, Pensacola, Fla. The other vice presidents are Eldridge S. Adams, Los Angeles, Calif.; Lieut. Col. Arne B. Frykholm, Stockholm, Sweden; Grp. Capt. Tragool Thavaravej, Bangkok, Thailand; and A. Buchanan Barbour, London, England.

Education

The New York University School of Education will inaugurate an **internship program for graduate nurses** with the beginning of the 1955 summer session on 5 July. Financed through Sloan Foundation grants, the program offers specialized study leading to either a baccalaureate or master's degree. A limited number of tuition scholarships will be available. All students will be granted a monthly stipend comparable to a staff nurse's salary. Subjects of study will include advanced clinical nursing in medicine, surgery, cancer, chemotherapy, rehabilitation, and principles of team nursing.

Colgate University, Hamilton, N.Y., has accepted an invitation to become affiliated with the Columbia University School of Engineering in the "combined plan for a liberal education in engineering." Colgate thus becomes the 44th private liberal arts college to become affiliated with the Columbia engineering school. Under this program, a student attends Colgate for 3 years and Columbia for 2 years, receiving degrees from both institutions. A "combined plan" student will receive an A.B. degree from Colgate and a B.S. degree in engineering from Columbia. Paul Ray Gleason, professor of physics at Colgate, has been appointed liaison officer and advisor for combined plan students there. Frank H. Lee of Columbia is chairman of the Combined Plan Committee.

A program for teaching law students the **relationship of psychiatry to modern legal problems** will be developed by the University of Pennsylvania Law School under an $89,640 Federal grant. The purpose of the 3-year project, which will begin 1 July, is to train law students in the behavioral sciences with specific attention to the development of teaching methods and

materials in the area of law and psychiatry. In addition, the project has four interrelated goals: (i) to improve communication between psychiatrists and lawyers and evolve effective teaching techniques through their academic collaboration; (ii) to compile and publish a coursebook and teacher's guide so that the results may be available to all law schools; (iii) to train the individual participants in the project, including the legal and psychiatric codirectors and their research associates; (iv) to accelerate the reception into law of further advances in psychiatry as they occur in the future.

An educational program that will enable college graduates to earn a doctorate in nuclear power while receiving regular industry-scale salaries through on-the-job training has been announced jointly by the Westinghouse Electric Corp. and the **University of Pittsburgh.** This is thought to be the first such program to be inaugurated in industry; it was arranged by A. C. Monteith, Westinghouse vice president in charge of engineering, and R. H. Fitzgerald, chancellor of the university. The plan will enable college graduates to spend part of their time studying at the University of Pittsburgh and part at the Bettis atomic power development laboratory in Pittsburgh. This laboratory is operated by Westinghouse for the Atomic Energy Commission.

Following the initial college-industry phase, graduates will become eligible for an educational leave. They will then return full-time to the university, on a tuition-paid basis, to complete work toward their doctorate. Tuition expenses will be reimbursed throughout the program, and while on educational leave, each graduate will receive a cost-of-living allowance that will take into account the number of his dependents. Salary increases will be granted, based upon on-the-job performance, just as to other Westinghouse employes.

A new radioactive cobalt-60 source, the most potent source of artificially produced nuclear radiation for cancer treatment yet made, has been installed in the **Argonne Cancer Research Hospital's** rotating therapy unit at the **University of Chicago.** The new source—a cylinder of cobalt ⅓ in. in diameter and 1 1/10 in. long—possesses a total radiation energy of 1225 e, which makes it one of the two or three most energetic sources in use in the United States.

The small size of the new source, particularly its small diameter, makes it possible to direct an x-ray beam into a tumor more accurately than heretofore. The new source delivers a dose of 23 r/min of gamma rays at a distance of a little over 30 in. A conventional 250,000 volt x-ray machine delivers a dose of about 30 r/min at a comparable distance under ordinary circumstances.

The establishment of a Library of Catholic Medical History at the **Georgetown University Medical Center,** Washington, D.C., has been announced. The library will serve as a repository for material describing the advances made by Catholics and Catholic institutions in the field of medicine. To initiate the project, the Raskob Foundation for Catholic Activities has awarded a $5000 grant that is to provide for the purchase, collection, and maintenance of manuscripts and books.

The director of the library will be Andrew A. Marchetti of Georgetown's faculty, and curator of the collection will be Margaret C. O'Byrne, Georgetown medical-dental school librarian. An appeal is made to Catholic doctors throughout the United States to send reprints of their scientific contributions to the library, and to biographers of the great physicians of the past to make their data available to Georgetown.

Grants, Fellowships, and Awards

The Medical Library Association will give two $150 scholarships to qualified students enrolled in the advanced **medical literature** and reference-work course that is being offered at the University of Illinois Library School, Urbana, 20 June–16 July. The last 3 days of the course will be devoted to practice in the Quine Library of Medical Sciences at the university's professional campus in Chicago.

Application for the scholarships should be made to the school at the time of application for enrollment in the course. These scholarships, the first to be given in the Midwest, have been offered previously at Emory University, Columbia University, and the University of Southern California. Applications for the scholarships *must be received by the Library School before 25 May.*

A new postdoctoral research fellowship program relating to multiple sclerosis and the other demyelinating diseases has been announced by the **National Multiple Sclerosis Society.** This program was made possible by an initial anonymous contribution of $102,000 to encourage qualified young scientists to devote themselves to research to find the cause, cure, and prevention of multiple sclerosis and related diseases.

Successful candidates will be designated as either fellows or scholars. Fellowships will be awarded to qualified candidates holding a doctorate in medicine or in related fields; they afford a basic stipend of $4000 to $5000 per year based upon the academic and professional training of the applicant and upon his family dependency status.

Appointment as a scholar will be made to an investigator holding a doctorate in medicine or a related field who has demonstrated competence in biological research. This award will provide a stipend of $6000 to $8000 per year based upon the academic record, professional training, and research attainments and interests of the applicant.

These awards will be made for 1 calendar year and may start any time within 8 mo of the date of notification of the award. One or two additional years of support may be requested; however, total tenure is not

expected to exceed 3 years. In all cases additional years of support are dependent upon the terms of the original award and upon continued endorsement by the sponsor.

Research fellows and scholars may work at any institution qualified to provide appropriate training. It is the responsibility of the applicant to make all necessary arrangements for the conduct of his proposed program, both with his prospective sponsor and the institution. Applications may be secured by writing to: Dr. Harold R. Wainerdi, Medical Director, National Multiple Sclerosis Society, 270 Park Ave., New York 17, N.Y.

The **Fund for the Advancement of Education** has announced the granting of 138 1-year fellowships to college and university faculty members. Aggregating approximately $800,000, these grants are the fifth and final series of annual awards given by the fund primarily to enable the recipients to become better teachers in their respective fields, which include the humanities, the social sciences, and the natural sciences. The awards have been made upon recommendation by the fund's National Committee on Faculty Fellowships, under the chairmanship of president Oliver C. Carmichael of the University of Alabama. Winners for the coming year were chosen from 700 applicants, and represent 99 institutions throughout the United States.

The **Robert Roesler de Villiers Foundation,** established specifically to encourage research on leukemia, will award grants-in-aid of not more than $1000 each to qualified investigators who apply to the Robert Roesler de Villiers Foundation, Inc., 1172 Park Ave., New York 28. *The closing date for application is 1 Aug.*

The **Rockefeller Foundation** has given the University of Wisconsin $250,000 to support a 4-year research program on methods to trap and directly utilize the energy of sunlight. The research program will be conducted at the university under the direction of Farrington Daniels, solar energy expert and chairman of the university's chemistry department. John A. Duffie of the College of Engineering will have charge of the administration and coordination of the university's present solar energy research program, which will also benefit from the grant.

In outlining the new program, Daniels pointed out that there is little chance in the near future of solar energy competing with coal, petroleum, and electricity in the industrialized nations, but that there is a good chance of its competing now with animal power and human labor. He added that the situation calls for a new research approach, with emphasis on low-cost equipment and simplicity, and that the development of cheap plastics is offering new hope for the economical use of sunlight. Sunlight is so diffuse and of such low intensity, Daniels explained, that large areas have to be used to collect sufficient heat to be useful. An area of ground can be covered with light-weight and easily transported plastic collectors and containers at only a fraction of the cost required for glass, metals, concrete, and other materials.

In the Rockefeller-financed research at Wisconsin, emphasis will be placed on the development of solar-energy collectors, solar cookers, solar distillation of salt water, solar-operated refrigerators, solar engines and irrigation pumps, and other means and methods of using solar energy; attention will also be given to problems of solar radiation measurement. A minor part of the program will be devoted to long-range studies of photochemistry, photosynthesis, photoelectricity and the storage of electrical energy.

Miscellaneous

The Society for American Archaeology has announced the appointment on 1 May of Raymond H. Thompson of the department of anthropology at the University of Kentucky as associate editor for book reviews. It is requested that henceforward all publications submitted for review in *American Antiquity* be sent to Dr. Thompson.

Release to open file of a report on **Photogeologic procedures in geologic interpretation and mapping** has been announced by the Department of the Interior. The report briefly describes numerous photogeologic procedures with regard to annotation of geologic data, determination of quantitative geologic data, limited base-map compilation, and transfer of geologic data to base maps. It has been placed on file for public inspection in the Geological Survey library, room 1033, General Services Administration Building, Washington, D.C.

In expanding its search for innovations that might lead to increased progress in the development of **Air Force weapons,** the Air Research and Development Command's Analysis and Evaluation Office has appointed M. W. Beardsley, Lt. Col., as assistant for innovations. His duties are to receive and study ideas from industry, universities, and private individuals engaged in research work. The ARDC hopes thus to reduce the time lag between the conception of a basic idea and its adoption by the Air Force. Causes of delays in the past have been an absence of communication between the innovator and the ultimate user, the user's inability to realize the potential of a new idea, and the high cost of preparing a proposal to the Air Force when no definite military requirement existed.

Proposals submitted to ARDC should describe the innovation, give estimates of expected performance, and explain the innovation's potential value to the Air Force. All proposals will be evaluated by ARDC experts in the branch of technology concerned. Correspondence should be addressed to the Assistant for Innovations, RDTE, Headquarters, Air Research & Development Command, Box 1395, Baltimore 3, Md. Contractors having established relations with ARDC laboratories or offices should follow their customary procedure for submitting new ideas.

Book Reviews

Faune de France. vol. 58, *Mollusques Opisthobranches.* Alice Pruvot-Fol. Lechevalier, Paris, 1954. 460 pp. Illus. + plate. Paper, F. 6500.

This is an exceedingly important study covering a subclass of mollusks that have been generally neglected in recent years. Many studies exist, of course, that cover certain groups, particularly the Nudibranchia, but treatment of the subclass as a whole has been almost nonexistent. France, bordering on both the open Atlantic and the Mediterranean, possesses two rather different faunistic areas. As a consequence, the scope of this work is large and in reality it covers most of the marine shores of Europe.

The figures are all line cuts and, with very few exceptions, are clear in their detail. These drawings show the shell as well as many anatomical structures. Shell-less forms have a drawing of the entire animal.

Unfortunately, and apparently to save space, the synonymies are reduced to only names and authors, with only an occasional date. This will necessitate much added labor for future students seeking original data. In addition, there is no bibliography.

W. J. CLENCH
Museum of Comparative Zoology, Harvard University

Grignard Reactions of Nonmetallic Substances. M. S. Kharasch and Otto Reinmuth. Prentice-Hall, New York, 1954. xxii + 1384 pp. $15.

The organic chemist heartily welcomes a volume that undertakes the gigantic task of summarizing and evaluating a half-century of research studies on the chemist's most prolific reagent, the Grignard reagent. The research chemist now possesses, in this one volume, a truly research-wise approach to the literature of the Grignard reactions of nonmetallic substances. Its value is strengthened by the unquestioned authoritative qualifications of the authors.

Chapter I presents the significant historical facts that led to Grignard's discovery, supplemented by important bibliographic material on the life of Grignard and Grignard reagent chemistry. Chapter II discusses in detail the preparation of Grignard reagents. It not only includes the many important factors concerned in their preparation but also presents a number of "illustrative preparations in the classical manner." Chapters III–V present, respectively, the estimation and detection of Grignard reagents, the constitution and dissociation of Grignard reagents, and some radical reactions of Grignard reagents. Chapters VI–XVI and XIX–XXIII discuss the reactions of the Grignard reagents with: (i) the important classes of organic compounds; (ii) the nonmetals—oxygen, sulfur, selenium, and tellurium; (iii) certain miscellaneous compounds of sulfur, selenium, and tellurium; (iv) silicon compounds; and (v) miscellaneous nonmetallic substances, such as halogens and compounds of boron and phosphorus. Chapter 17 deals with allylic rearrangements, and chapter 18 discusses the method for the determination of "active" hydrogen. The method of presenting each chapter, although varying with the nature of its content, follows a definite pattern that includes a brief historical résumé, a definition of the so-called "normal" reaction, a consideration of mechanisms, descriptions of exemplary preparative procedures, a consideration of "abnormal" reactions, and a tabulation (or tabulations) of literature data.

The authors have increased the value of the work by including details that are of especial value to the research worker. For example, the table of contents includes subtopics under the main headings, together with page references. The table of contents is followed by a list of the titles of 87 tables of data with page references. Furthermore, an unusually helpful list of individual Grignard reagents according to empirical formulas is presented in a special index. This index also includes answers to questions relating to the literature listing of a given reagent, its preparation, properties, and the types of coreactants with which it has been treated. A general index of more than 20 pages, with a listing of approximately 1500 items, appears complete.

The value of this contribution to the literature of organic chemistry is nothing short of tremendous, since the Grignard reagent has established itself firmly in every area of this field. It is a "must" for every library of chemistry—industrial or academic—and the individual research chemist in the field of organometallic compounds will find it indispensable.

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Liver Injury. Transactions of the twelfth conference, 21–23 Sept. 1953. F. W. Hoffbauer, Ed. Josiah Macy, Jr. Foundation, New York, 1954. 231 pp. Illus. $4.25.

This conference was devoted to the role of the liver in the metabolism of fat, protein, and carbohydrate. The book presents a lively and helpful review of some of the newer concepts(and controversies) that have evolved from recent work. The discussions repeatedly draw attention to the interweaving relationship of the metabolism of these three major foodstuffs—a relationship that stems from the fact that certain important metabolic intermediates are common to the biochemical cycles of all three. This commonage has aggravated the difficulties that always plague experimentalists when they turn from studies on the whole animal to analyzing separate functions by means of isolated systems.

E. Lundsgaard challenges prevailing views in stat-

ing that: (i) insulin does not promote glycogen storage in liver through a direct effect on liver tissue, and (ii) in the liver, the extent of carbohydrate metabolism has no influence on the rate of ketone body formation.

J. P. Hoet describes how the diabetogenic effect of pregnancy taxed the pancreas of a potentially diabetic woman, producing overt diabetes in mother and child, albeit years later. Transient hyperglycemia of pregnancy is a forerunner of clinical diabetes and should be treated early if the disease is to be prevented in mother and offspring.

S. Gurin shows that the liver oxidizes fatty acids to acetyl-coenzyme A by a process essentially similar to that postulated in the beta-oxidation theory, except that all the intermediates are present in the activated state (attached to coenzyme A). He also suggests that the process is probably reversible. This points up the importance of glycosis in fatty acid synthesis since pyruvate can be synthesized to fat through the common intermediate, acetyl-coenzyme A.

H. W. Kosterlitz discusses the effects of dietary protein on the liver. Since kwashiorkor, a human disease associated with protein deficiency, has not yet been reproduced in animals, the basic metabolic faults remain unclarified.

Two short subjects of special interest to pathologists are "Cardiovascular lesions in choline-deficient rats," by W. S. Hartroft, and "Hepatic lesions produced in rats with ethionine," by H. Popper.

One regrets that this conference must be the last, especially when confronted by the impressive list of unsolved problems in human liver disease that were compiled at the end of the conference. The last sentence of the proceedings epitomized the situation: "Shall we agree that there are still many fascinating clinical and experimental problems?"

I. N. DUBIN

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Oral Pathology. A histological, roentgenological, and clinical study of the diseases of the teeth, jaws, and mouth. Kurt H. Thoma. Mosby, St. Louis, Mo., ed. 4, 1954. xviii + 1536 pp. Illus. + plates. $22.50.

The fourth edition of Thoma's *Oral Pathology* is another encyclopedic work. It has been revised and expanded since publication of the last edition 4 years ago. Most chapters have been thoroughly revised. The chapter on dental caries has been completely rewritten, and Goldman's chapter on periodontal disease has been revised and new illustrations added. Many excellent black-and-white illustrations and several new color illustrations have been added.

It is difficult to find a subject within the field of oral pathology that is not adequately discussed in this textbook. Not only are prevailing views presented but, in instances where the discussion type of references are available, these are included.

Although opinions on order of presentation may vary, I feel that the new arrangement has somewhat detracted from its usefulness as a textbook. Diseases of the teeth are discussed first, then diseases of the head and jaws, abnormalities of the temporo-mandibular joint, diseases of nerves and muscles, mouth diseases, diseases of salivary and mucous glands, and finally tumors. This arrangement leads to frequent repetition. For example, actinomycosis is rather completely discussed in three chapters, and gingivitis is presented in three chapters, in each case with frequent repetition. However, this arrangement and these repetitions detract only slightly from the total value of the book. The only severe criticism, that of the size of the book, is valid only in considering it as a textbook for undergraduates. Its 1536 pages are devoted to the special pathology of one region. The references occupy more than 116 pages. The work is exhaustive and up to date.

Thoma's *Oral Pathology* is the most complete and authoritative book on the subject. It should be considered as an essential reference book for all pathologists and practicing dentists. As a textbook, it presents the difficulty of great length, but no better one is available. The capable instructor may teach his students to use it for a reference book as well as for a textbook.

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The Foundations of Statistics. Leonard J. Savage. Wiley, New York; Chapman & Hall, London, 1954. xv + 294 pp. $6.

Any treatise on the foundations of statistics must of necessity be concerned in large measure with probability. Savage's book is essentially his exposition of probability as it relates to statistical problems. Since the postulates of probability are highly controversial, this book will also be highly controversial.

The first half is concerned with the development of the author's concept of personal (subjective) probability, especially with reference to the decision-making problem. He suggests that this problem can be more effectively dealt with through his concept of personal probability than through the concepts of mathematical probability. He bases this view on the contention that mathematical probability cannot cope with personalistic evaluations of risk since these are conditioned by the mental state of the individual.

This may appear to be a strange basis for the science of statistics. However, cast in the framework of the decision-making problem, it becomes more reasonable. The problem of the individual confronted with uncertainty is also shown to be related to the modern theory of utility as developed by von Neumann and Morgenstern.

The remainder of the book is devoted to a discussion of the major problems of statistics (such as minimax theory, estimation, and testing) in the light of personal probability. In the discussion of minimax

theory, personal probability appears to be most relevant and gives rise to some searching and fundamental questions. As the author states in his introduction,

> . . . the superficially incompatible systems of ideas associated on the one hand with a personalistic view of probability and on the other with the objectivistically inspired developments of the British-American School do in fact lend each other mutual support and clarification.

As the title suggests, the book is highly theoretical and abstract. The formal discussion is presented symbolically and is frequently introduced by oversimplified problems of the world around us. A study such as this is intended for a very limited audience—specifically, those interested in the abstract theory of statistics.

The author is not prepared, nor am I, to say how far reaching this unique approach to statistics will be, but it does give rise to a number of important and unanswered questions.

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Colorimetric Methods of Analysis. Including some turbidimetric and nephelometric methods. vol. IV. Foster Dee Snell and Cornelia T. Snell. Van Nostrand, New York, and Macmillan, London, ed. 3, 1954. vii + 676 pp. Illus. $12.50.

Volume IV of this comprehensive treatise presents methods for the colorimetric chemical analysis of organic materials that were not covered in volume III. The present volume contains chapters dealing with the following classes of compounds: nitrites, nitrates and nitro compounds; aliphatic amines and amides; amino acids; proteins; aromatic primary, secondary, and tertiary amines; azo compounds, nitrogen-containing cycles, and so forth; urea and related compounds; compounds with inorganic radicals; sterols; hormones; alkaloids; enzymes; antibiotics; hemoglobin and related compounds; and natural pigments. In addition, there is a brief chapter on the determination of the color of liquids.

Each of the foregoing chapters is divided into sections that cover the analysis of either a specific compound or a closely related group of compounds. A typical section contains a paragraph or two covering the methods available for the analysis, the interfering substances and methods for eliminating the interference, and the types of sample to which the various methods are applicable. A section that deals with the preparation of samples of various types for the analysis follows. Finally, the actual procedure for the development of the color and its estimation is described.

The preface states that the aim has been completeness, and it appears that this is very nearly what the authors have achieved. With the wealth of colorimetric methods available for the analysis of these compounds, it is amazing that the Snells have been able to incorporate in the space available not only the actual directions for the analyses but also the discussions on applicability of the methods and interfering substances. This feat was accomplished through the use of a terse, economical style of writing so that one has to search through the book to find a single wasted word. This will be no hardship to the skilled analytic chemist, who knows that the bare instruction "dilute to 100 ml." may mean the use of a volumetric flask in one case or a graduated cylinder in another, depending on the precision desired. Complete references to the literature are provided, and there are extensive author and subject indexes. I noticed a few instances of misspelling in the bibliography; in some cases the author is listed both under his correct name and under a misspelled version.

This book should prove of great value, both as a reference work and as a guide to the literature, to all analytic chemists who use colorimetric methods.

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Wasserbestimmung mit Karl-Fischer-Losung. Ernst Eberius. Verlag Chemie, Weinheim/Bergstr., Germany, 1954. 138 pp. Illus. Paper, DM. 12.80.

This monograph is, in large part, a condensation and a literal translation of *Aquametry*, by John Mitchell, Jr., and Donald M. Smith (Interscience, 1948).

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Technical Papers

Demonstration of Hemoglobin-Reactive Substance in Human Serum

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During a previous study (*1*) I found that fetal and adult hemoglobins exhibit electrophoretic mobilities similar to that of the β-globulin fraction of serum when they are analyzed by filter-paper electrophoresis using veronal buffer at *p*H 8.6. The addition of serum of new-born infants to the hemoglobin solutions before electrophoresis did not appear to alter the electrophoretic characteristics of either of the two types of hemoglobin. It was later observed that hemoglobin present in specimens of serums obtained from older children exhibited a mobility more nearly that of α_2-globulin. This observation prompted the studies described here.

Filter-paper electrophoresis was carried out as is previously described (*1*), using Whatman 3-mm filter-paper strips 1 in. wide. After the completed strips were dry, each was cut longitudinally into two ½-in. strips, one of which was stained with bromphenol blue to show the location of the major serum proteins; the other was stained with benzidine to localize hemoglobin or other hematin compounds. Substances giving a positive benzidine reaction were therefore accurately localized with respect to the serum proteins.

Hemoglobin present in the serum of newborn infants as a result of hemolysis during withdrawal of blood and separation of serum migrated at a rate similar to that of β-globulin. The addition of either fetal or adult hemoglobin (identified by the method of Singer *et al.*, *2*) to serums obtained from newborn infants resulted in an increase in the intensity of the benzidine stain in the β-globulin area on the completed electrophoretic record. In contrast, the electrophoretic mobility of hemoglobin in serum of older children and adults was such that the hemoglobin migrated to a point corresponding to that of the α_2-globulin. Addition of serial dilutions of either adult or fetal hemoglobin to adult serum followed by electrophoresis resulted in a progressive increase in intensity of the benzidine strain in the α_2-globulin area corresponding to the amount of hemoglobin added to the specimen of serum. As the hemoglobin concentration was progressively increased, a point was eventually reached at which no further increase in intensity of the benzidine stain in the α_2-globulin area occurred. At this point a benzidine-positive compound, presumably hemoglobin, began to appear at the β-globulin position; further increase of the concentration of hemoglobin in the specimen resulted in a progressive increase in intensity of the benzidine reaction in this area. Specimens of serum from a limited number of individual children have been "titrated" in this manner and considerable variation was observed in the extent to which the serum was capable of altering the mobility of hemoglobin. Dialysis of serum and hemoglobin solution against the buffer solution prior to electrophoresis did not modify the results.

Serum was obtained from a well child aged 10 yr. The major serum proteins were separated from 0.1 ml of the specimen using a strip of Munktell No. 20 filter paper 4 in. wide. After electrophoresis, while the paper was still wet, one 1-in. strip was cut longitudinally from each side of the paper. These smaller sections were quickly dried and stained with bromphenol blue and then were used as guides for sectioning the remaining 2-in. center strip of paper, so that each section contained one of the major serum proteins. Each of these sections was then placed in a separate tapered centrifuge tube into which had been placed seven or eight small clean glass beads. The tubes were then centrifuged and the liquid in the bottom of each tube, which represented a relatively pure diluted sample of each of the major serum proteins, was removed. Each fraction obtained in this manner was then mixed with a small amount of dilute hemoglobin, after which each protein-hemoglobin mixture was subjected to electrophoresis and stained as is described in the second paragraph. Hemoglobin not mixed with other protein was run simultaneously as a control. The mobility of hemoglobin was not increased by albumin, α_1-, β-, or γ-globulin. Two hemoglobin bands were present in the α_2-globulin-hemoglobin mixture, however; a faint but definite band was observed in the area corresponding to free hemoglobin, but the major part of the hemoglobin migrated at the rate of the α_2-globulin.

These data indicate that the serum of children and adults ordinarily contains a substance (or substances) capable of altering the electrophoretic mobility of hemoglobin, presumably by molecular interaction resulting in complex formation. This substance is absent in the serum of newborn infants, and, according to results of our preliminary observations, it begins to appear during the first few weeks of life.

The activity of this substance does not seem to be influenced by the type of hemoglobin present in the serum, for reactions with both fetal and adult hemoglobins have been demonstrated. The nondialyzable nature of the substance suggests that it is of relatively large molecular size. Electrophoretically, under the experimental conditions employed, it has been identified with α_2-globulin(s).

Qualitative experiments indicate that the concentration of this hemoglobin-reactive substance may undergo alterations in certain diseases; however, the number of determinations carried out to date is not adequate for final interpretation.

It is perhaps significant that the interaction of a

compound that is primarily protein in nature—that is, hemoglobin—with another substance found in the serum results in a profound change in the electrophoretic characteristics of the hemoglobin. This emphasizes the possibility that characteristic alterations in the electrophoretic pattern of serum proteins seen in certain diseases may be the result, at least in part, of complex formation occurring between normal serum proteins and other substances not ordinarily present in the serum.

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* John and Mary R. Markle Foundation scholar in medical science. This investigation was supported in part by research grant H1380 from the National Institutes of Health, U.S. Public Health Service.

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15 November 1954.

Hydrolysis of Amylotriose by Crystalline Salivary Amylase

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In an earlier publication (*1*) it was shown that partially purified preparations of salivary amylase were capable of hydrolyzing the glucosidic bonds of amylotriose to yield glucose and maltose as the hydrolytic products. Whelan and Roberts (*2*) did not observe any hydrolytic products in digests of amylotriose (maltotriose) with highly purified salivary amylase, and they concluded that the enzyme was without action on this compound. In our laboratory, crystalline salivary amylase (*3*) has now been shown to effect a hydrolysis of amylotriose and of 1-C^{14}-amylotriose. The results of our studies are presented in this paper (*4*).

Four milligrams of amylotriose were dissolved in 0.05 ml of water and treated with 0.05 ml of a solution of crystalline salivary amylase. The enzyme solution was buffered to *p*H 6.8 with 0.1*M* phosphate and assayed 12 units (*5*) of amylase activity per milliliter. An aliquot of 0.01 ml of the digest was placed on a paper strip immediately after the addition of the enzyme and was heated at 100°C for 5 min to inactivate the enzyme. Subsequent samples were obtained at 6- and 24-hr reaction periods. The reducing sugars in the aliquots were separated in *n*-butyl alcohol-pyridine-water (6:4:3 by volume) solvent and located on the paper with copper sulfate reagent (*6*). A photograph of the chromatogram is reproduced in Fig. 1. Filtered saliva containing 12 units of amylase activity per milliliter was also tested on amylotriose under conditions identical to those of the preceding experiment. The finished chromatogram of this digest was the same as that reproduced in Fig. 1.

In order to determine which bond in the trisaccharide was susceptible to enzyme hydrolysis, 1-C^{14}-amylotriose was subjected to the action of the crystalline amylase. Four milligrams of 1-C^{14}-amylotriose (*7*) dissolved in 0.05 ml of water was treated with 0.05 ml of the solution of crystalline enzyme. Aliquots of the digest were analyzed for reducing sugars by paper chromatography at 0-, 6-, and 24-hr reaction periods. The areas at which reducing sugars appeared on the chromatogram were cut from the paper and counted for radioactivity in a conventional counting apparatus. The radioactivities of the various compounds are recorded in Table 1.

An examination of Fig. 1 shows that, under the conditions of our experiments, amylotriose was rapidly hydrolyzed to glucose and maltose by crystalline salivary amylase. In a 6-hr reaction period, considerable hydrolysis of the trisaccharide had already occurred, while in a 24-hr reaction period more than 75 percent of the trisaccharide was hydrolyzed to glucose and maltose. Comparison of the chromatogram in Fig. 1 with that obtained for the samples of amylotriose treated with crude saliva revealed that, at equivalent concentrations of amylase activity, the crystalline and crude enzyme preparations hydrolyzed amylotriose at the same rate. In addition, neither the crude preparation of saliva nor the crystalline amylase preparation exhibited any maltase activity. On the basis of these findings, it would appear that the hydrolysis of amylotriose is the result of amylase activity and not of the activity of maltase or some yet unidentified enzyme in saliva (*8*). The discrepancy in the results obtained by Whelan and Roberts (*2*) and by us may be due to differences in enzyme concentrations or in some other reaction condition.

The values in Table 1 for the radioactivities of the products from 1-C^{14}-amylotriose show that salivary amylase is capable of hydrolyzing the glucosidic bonds at the reducing and nonreducing end of the amylotriose molecule. Hydrolysis of the bond nearest the reducing end leads to the production of radioactive

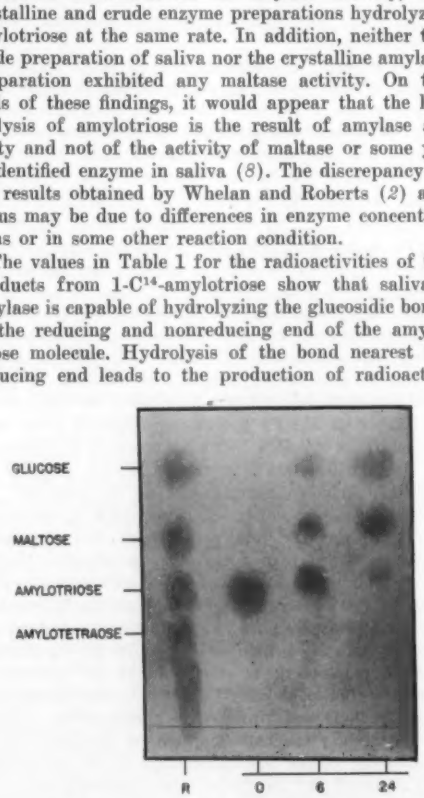

Fig. 1. A triple-ascent paper chromatogram of the digest of amylotriose and crystalline salivary amylase at several stages of enzymolysis: R, reference amylooligosaccharides.

Table 1. Radioactivities of products in the digest of 1-C^{14}-amylotriose with crystalline salivary amylase.

Compound	0 hr (counts/min)	6 hr (counts/min)	24 hr (counts/min)
Glucose	8	185	366
Maltose	4	156	226
Amylotriose	692	350	107

glucose and nonradioactive maltose, while hydrolysis of the bond nearest the nonreducing end leads to the formation of nonradioactive glucose and radioactive maltose. Since the radioactivity of the glucose produced from 1-C^{14}-amylotriose was consistently higher than that of the maltose, a faster rate of hydrolysis is indicated for the glucosidic bond nearest the reducing end. It is generally believed that alpha amylase action on starch and starchlike compounds proceeds from both the reducing and the nonreducing end of the molecule. These results support this type of action pattern for salivary amylase.

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26 January 1955.

Method for Tracing Dark Adaptation in the Pigeon

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Animal subjects are not often used in psychophysical research, because they cannot follow complex instructions or report verbally what they see or hear. The method described in this paper represents an attempt to overcome these difficulties and to obtain with animals some of the efficiency and control that human subjects provide. The method owes much to the work of Skinner and his associates (*1*) and to Békésy's method of human audiometry (*2*). The procedure outlined here is designed for the study of dark adaptation in the pigeon (*3*), but, with modifications, it may be applied to a variety of animal discrimination problems.

Automatic apparatus is used. It includes the following items: (i) a light-tight adaptation box, containing pigeon, response keys, food magazine, and stimulus patch; (ii) a network of relays and timers that control the stimulus luminance and the presentation of food; (iii) a light source and an optical system, with a device that continuously records the stimulus luminance.

A panel divides the adaptation box into two chambers. The bird is trained to stand in one chamber and place its head through a round hole in the panel (Fig. 1). The bird faces a small window through which it views a stimulus patch, 1 cm in diameter, 4 cm beyond the frame of the window. The only light in the adaptation box comes from this stimulus patch. There are two small response keys, *A* and *B*, just below the window. Each peck on one of these keys momentarily opens a switch that is connected with the controlling relay network. When the bird is to be rewarded, a solenoid raises a magazine containing grain to an opening in the floor below the response keys.

The stimulus patch is illuminated from behind by a beam of light. A motor-driven optical wedge in the path of the light beam regulates the luminance of the patch. A shutter may be closed to black out the stimulus patch completely. The movements of both the wedge and the shutter are controlled through the relay network.

The pigeon's basic task is to peck key *A* when the stimulus patch is visible and to peck key *B* when the patch is dark. Training on this discrimination proceeds in several stages. When the bird becomes proficient at one stage, the next stage is introduced; 50 training hours may be needed before experimental data can be collected.

First, the hungry bird (70 to 80 percent of free-feeding cage weight) is trained to peck the two keys at random by the "response differentiation" technique described by Ferster (*4*). Next, the stimulus patch is illuminated, and the control circuit is so adjusted that a peck on key *A* closes the shutter, blacking out the patch. After a peck on key *A* has blacked out the patch, a peck on key *B* causes the food magazine to be raised within reach for about 5 sec. Pecks on key *B* are useless when the patch is lighted, and pecks

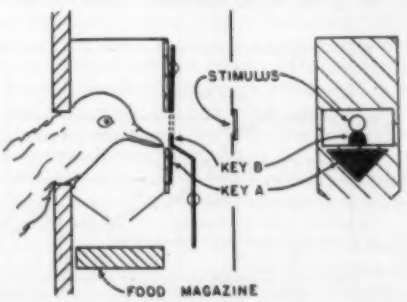

Fig. 1. Response chamber of the adaptation box. (Left) Side view, showing relative positions of pigeon, food magazine, response keys, and stimulus patch. (Right) Keys *A* and *B* and patch seen from the pigeon's position.

on key *A* are useless when the patch is dark. After most rewards, the shutter opens, and the lighted patch reappears. Continued darkness follows one reward in five; in this case, a peck on key *B* brings food a second time. These double rewards train the bird to attend to the stimulus patch after eating; without them, the bird would always peck key *A* after eating, regardless of the condition of the stimulus patch.

In the next stage of training, several pecks in a row, rather than a single peck, are required on key *A* to close the shutter and on key *B* to obtain food. The number of pecks required is varied randomly between one and eight. This increases the time between rewards and prevents the bird from getting a reward simply by pecking the two keys alternately, without attending to the stimulus patch. The time between rewards is further increased by introducing an interval after each reward during which no amount of pecking can close the shutter. The duration of this interval varies randomly about a mean of 7 sec.

When training is nearly complete, a final feature is added to the procedure: the luminance of the stimulus patch is put under the control of the bird's responses during the intervals between rewards. Each peck on key *A* reduces the luminance of the patch by a small amount, while each peck on key *B* increases the luminance of the patch. A pen continuously records these luminance changes. When the bird has learned to perform consistently under these conditions, the collection of threshold data can begin. Experimentation continues indefinitely without further alteration of procedure.

An account of a typical experimental session will serve to illustrate how the bird's threshold is traced. At first, the stimulus patch is brightly lighted, and the trained bird pecks only key *A*. The bird continues to peck key *A* until the patch becomes so dim that it falls below the bird's absolute threshold. Because the pigeon cannot distinguish this "dim-out" of the patch from the true "black-out" caused by the closing shutter, it begins to peck key *B*. But pecking key *B* increases the luminance of the patch, so in a short time the patch again becomes visible to the bird.

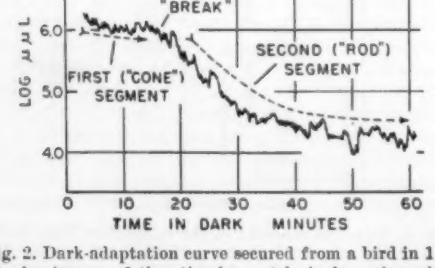

Fig. 2. Dark-adaptation curve secured from a bird in 1 hr. The luminance of the stimulus patch, in log micromicrolamberts, is on the ordinate.

When this happens, the bird switches its pecking back to key *A*, causing the stimulus to dim and to disappear as before. This process continues indefinitely; the bird alternately pecks keys *A* and *B*, and the stimulus fluctuates up and down across the bird's absolute threshold. The continuous record of the stimulus luminance traces the bird's absolute threshold through time. The randomly spaced rewards, when pecks on key *A* close the shutter and pecks on key *B* bring food, interrupt the continuity of this threshold record frequently but for only a few seconds.

During the first portion of an experimental session, the recording pen traces the pigeon's dark-adaptation curve. A reproduction of such a curve in a 1-hr session is shown on appropriate coordinates in Fig. 2. Before this particular session, the bird had spent 1 hr in darkness, followed by 10 min in a box with white walls at a luminance of 22 millilamberts.

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3. This research was supported in part by contract N5ori-07663 (project NR140-072) between Harvard University and the Office of Naval Research, directed by Floyd Ratliff. It represents part of a thesis submitted to the Department of Psychology, Harvard University, in partial fulfillment of the requirements for the Ph.D. degree. I am indebted to Ratliff for his constant interest and helpful advice. Present address: National Institute of Mental Health, Bethesda, Md.

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19 January 1955.

Chromatographic Separation of Polybromo Fatty Esters

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It was observed some time ago in connection with the preparation of certain carboxy-labeled fatty acids (*1*) that 1-bromoheptadecane is rapidly eluted from alumina by petroleum ether while 1,8,9,11,12-pentabromoheptadecane is not. An order of magnitude of affinity between vicinal pairs of bromine substituents and the hydrogen-bond-contributing type of adsorbent (such as alumina or silica) that had not been appreciated previously was thus revealed; it occurred to us that this observation might be the basis for a new approach to the problem of separating fatty acids differing in degree of unsaturation (*2*).

Recent studies (*3*) have shown clearly that the ease with which fatty acid esters are eluted from alumina or silica columns is an inverse function of the number of carbon-carbon double bonds that they contain; but the separations achieved are at best fair and the yields of pure constituents recovered are poor, reflecting a small contribution of the olefinic centers to the overall adsorption affinity of such substances. (In these studies, as well as in our own, the strongly polar carboxyl group of the free fatty acids is esterified in

order to make the contribution of the centers of unsaturation—actual or potential—as dominant as possible.)

It has now been demonstrated that the addition of bromine to unsaturated fatty acid esters enhances the adsorption-affinity contribution of each unsaturation site to such an extent that the resulting esters, differing in the number of pairs of vicinal bromine substituents that they contain, are easily and cleanly separated by gradient elution from alumina chromatographic columns. The original unsaturated fatty acids may then be regenerated from the separated polybromo fatty esters by conventional debromination and saponification procedures.

Resolution of an artificial mixture of methyl stearate (MeS), methyl *threo*-9,10-dibromostearate ($MeSBr_2$), and methyl *threo,threo*-9,10,12,13-tetrabromostearate (α-$MeSBr_4$, mp 56°C) is illustrated in Fig. 1. (Methyl esters are used because of their facile, quantitative preparability via diazomethane; the size or shape of the esterifying group does not appreciably affect the chromatographic behavior of a fatty acid ester.) Since MeS and α-$MeSB_4$ are crystalline substances and $MeSB_2$ is an oil, the efficacy of the separation of such a mixture is dramatically evident in practice.

Columns employed for the chromatography of about 500 mg of mixed polybromo fatty esters measure about 32 (diameter) by 100 mm and are packed in the dry state; the adsorbent is Harshaw alumina (AL-0109-P) reground to pass a No. 200 sieve and mixed 40 : 7 by weight (about 2 : 1 by volume) with vacuum-dried celite 535.

Chromatograms of artificial mixtures (see Fig. 1, in which 200 mg of each ester was placed on the column) show that recoveries are not quantitative, presumably as a consequence of saponification by basic impurities in the alumina employed. Attempts to avoid such losses by the neutralization of the adsorbent have been unsuccessful. Silica columns are much more inert in this respect, but the resolving power of this adsorbent is inferior; resolution of a mixture of MeS and α-$MeSBr_4$ on silica (eluting throughout with 2 percent ether in pentane) was appreciable but far from complete.

Application of the new technique to material derived from a naturally occurring mixture of fatty

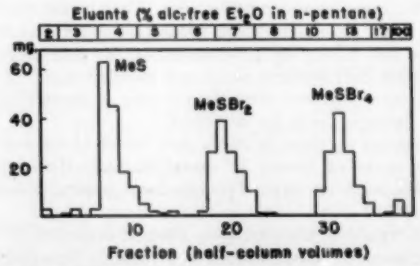

Fig. 1. Chromatogram of an artificial mixture of MeS, $MeSBr_2$, and α-$MeSBr_4$.

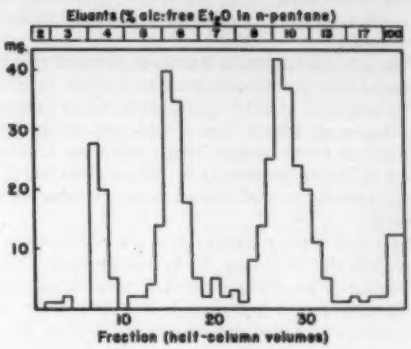

Fig. 2. Chromatogram of brominated poppy seed oil fatty acid methyl esters.

acids (poppy seed oil fatty acids from which most of the saturated and the 115°-9,10,12,13-tetrabromostearic acids had been removed) resulted in the chromatogram shown in Fig. 2. The three major peaks represent, as confirmed by ultimate analyses, methyl esters of bromine-free, dibromo, and tetrabomo fatty acids in order of elution. The tetrabromo fraction is presumed to consist almost entirely of the lower-melting (previously unknown in this state of purity) diastereoisomeric methyl *threo,threo*-9,10,12,13-tetrabromostearate (β-$MeSBr_4$).

Chromatography of materials derived from natural fatty acid mixtures containing linoleic acid has consistently given tetrabromide peaks, the fractions in the leading half of which are crystalline, while those emerging later are oils. A slight difference in adsorption affinity of the two esters (α- and β-$MeSBr_4$) expected to result on addition of bromine to methyl linoleate is thus indicated, and this difference has been confirmed by studies of the behavior of artificial mixtures of α- and β-$MeSBr_4$. The difference is not, however, of sufficient magnitude to result in overlap of the complex $MeSBr_4$ peak with those of $MeSBr_2$ or $MeSBr_6$ on either side. Thus, inasmuch as all the 2^{n-1} diastereoisomeric racemates expected to result from saturation with bromine of a fatty acid ester containing n isolated carbon-carbon double bonds will be expected to emerge from the chromatographic column as a discrete band, the present procedure has obvious advantages over the classical method of isolating small amounts of polyunsaturated fatty acids. The latter method, which depends upon solvent fractionation of the crystalline brominated fatty acids, promises recovery of no more than a fraction (2^{1-n}) of the individual unsaturated fatty acid originally present in the mixture.

It should be emphasized that the length of the fatty acid chain is a factor of negligible importance in determining the elutability of a brominated fatty ester from an alumina column; thus, a mixture originally containing both oleic and palmitoleic acids would be expected to give rise to a single dibromo ester peak containing material derived from both parent sub-

stances. (Similarly, Fig. 2 illustrates the emergence of the methyl esters of stearic and palmitic acids as a single peak.)

Although our attention has been focused on applications of this chromatographic procedure to separation of mixtures of fatty acids, there would appear to be no reason to believe that it could not be applied to other classes of compounds that contain no functional groups of sufficient polarity to eclipse the absorption-affinity contribution of vicinal pairs of bromine substituents.

These preliminary observations are published in the belief that the technique holds considerable promise as a means of sampling saturated, mono-unsaturated, and di-unsaturated fatty acids obtained from quite small amounts of naturally occurring lipids. We are currently engaged in such applications and in studies of the chromatographic behavior of fatty acid esters obtained by bromination of more highly unsaturated substances and of those containing isolated single bromine substituents in addition to vicinal pairs of bromine substituents.

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10 January 1955.

Communications

More on Induction of Tooth Defects by Thermal Shock

The communication by D. G. and H. A. Pohl [*Science* **120**, 807 (1954)] is interesting, but it appears to be based on several assumptions that do not appear valid from either clinical or histological viewpoints.

The first generalized assumption of "changed eating habits" carries with it the statement of present-day exposure of the teeth to extremes of temperatures and consequent probable induction of small cracks. Clinical observations clearly demonstrate that the anterior teeth are shielded by the lips when food or beverage of extreme temperatures are placed in the mouth. Complaints by patients of thermal sensitivity usually indicate a latent period of 10 to 15 sec. Extensive experience in clinical dentistry has clearly shown me that cracks of the dental enamel, when present in children or young adults, are the result of direct trauma; in the aged, they are found in the anterior teeth when the occlusion is of an end-to-end relationship. In the latter, roentgenograms will also disclose narrowing of the pulp chambers and canals, which probably indicates diminishing metabolic activity.

The second assumption, that the tooth enamel can be compared to the physical properties of "vitreous materials," is not sound. A glass or bone china dish is of homogeneous structure, whereas the dental enamel is a complex organ. In youth, and throughout life, remnants of an outer protein covering (primary surface cuticle) ensheath the millions of enamel rods that are closely intertwined in the cuspal areas. Each rod is encased by an organic sheath [D. B. Scott *et al.*, *J. Dental Research* **31**, 74 (1952)] and cemented to the adjacent rods by dense interprismatic material. To suggest that there is an implied validity in equating the smashing action of a weight on a dried extracted tooth (it is not stated whether the specimens are single or multirooted teeth) lying horizontally on a concrete floor with the normal occlusal forces on cusps or incisal edges of the teeth suspended by an elastic periodontal membrane in an alveolar socket is open to criticism.

Since the basis for the entire experiment is the hypothesis that cracks induced by thermal shock "furnish entrance sites for bacterial decay," one should expect a greater incidence of dental decay on the labial surfaces of incisor teeth that are more susceptible to such thermal shocks. All statistical evidence relative to the incidence of dental decay points to the immunity of the lower anterior teeth and of the labial surfaces of the upper anterior teeth.

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9 March 1955.

Although we feel that our communication was only a brief preliminary to necessary extensive work, and was, therefore, undeserving of any extended analyses, we feel that certain misunderstandings evident in Kamrin's comments may require clarification.

We agree wholeheartedly with Kamrin that further and more conclusive work needs to be carried out to show the fallacy or true extent of the indication in the data that thermal shock can damage teeth. If the inference is proved true, then a cure or abatement of the damage needs to be found.

Kamrin appears to imply that direct blows are the only cause of cracks in dental enamel. Have other causes, such as thermal shock, been generally recognized?

In regard to his comments about comparison of the resistance of dental enamel and ceramic materials to thermal shock, we would recall that crystallinity generally plays a very minor role. Whether or not a hot

drinking glass will crack if doused with cold water does not depend greatly upon the content of crystalline material in the glass. The development of cracks in materials by thermal shock is more a matter of temperature gradients, coefficients of thermal expansion, internal strains, and strengths of materials. Incidently, glass or bone china are not strictly homogeneous structures. For example, bone china may be comprised of about 50 percent of crystalline material and 50 percent of amorphous. Ordinary glass frequently contains some 0.1 to 1.0 percent of crystalline material.

Contrary to Kamrin's statement, we did not equate the smashing action of a weight to the normal biting action experienced by teeth. Our purpose, as is abundantly clear from the communication, was to find a test, of whatever character, that would distinguish between teeth bearing high or low levels of strains and cracks.

His comments on the statistics of caries incidence in various locations of the mouth are interesting and we agree that this type of information will help us in properly assessing the problem; provided one takes into account such factors as our normal tendency to flip bites of hot food from the front teeth to between the molars with the tongue.

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15 March 1955.

Isomerization of β-Carotene with Sunlight

Zechmeister and his associates have studied the isomerization of β-carotene by various methods, including fusion, refluxing its solution, use of iodine catalysis, shaking its solution with hydrochloric acid, and insolation (exposure to sunshine in the absence of catalyst) (*1, 2*). They obtained, by insolation, besides 98-percent recovery of all-*trans* β-carotene, 1 percent each of neo-β-carotene-U and neo-β-carotene-B (*2*).

In my work (*3*), in addition to neo-β-carotene-U and neo-β-carotene-B, the formation of neo-β-carotene-E was confirmed. A solution of chromatographically pure β-carotene (16 mg) in hexane (150 ml) was placed in a Pyrex measuring flask irradiated with direct noontime sunlight for 1.5 hr, and then chromatographed on lime-Celite (2:1). The appearance of the developed chromatogram is described in Table 1.

Table 1. Appearance of developed chromatogram. The numbers in parentheses in column 3 are the light absorption maxima in millimicrons used to characterize the zone materials.

Zone width (mm)	Zone color	Zone identification
2	Orange	Irreversible layer (heterogeneous)
15	Almost colorless	
25	Reddish orange	Neo-β-carotene-U (480, 450)
5	Almost colorless	
62	Dark orange	β-Carotene (486, 454)
28	Dark yellow	Neo-β-carotene-B (476, 444)
2	Almost colorless	
12	Pale reddish	Neo-β-carotene-E (480, 447)

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2. L. Zechmeister and A. Polgar, *J. Am. Chem. Soc.* **66**, 137 (1944).
3. I wish to thank L. Zechmeister for his kind advice.

2 February 1955.

Note on the Al and Si Positions in Ordered Na and K Feldspars

The condition of disorder among the Al and Si positions in Na and K feldspars is well known, and the degree of disorder is measurable (*1*). To date, x-ray analysis has not been successful in determining the Si and Al positions in the ordered minerals. However, it is theoretically possible to predict the structural positions of Al and Si in the ordered mineral and to substantiate the prediction by observations of certain features that are described here.

The ordered or lowest energy level for the mineral would be expressed on the atomic level by having the highest polarizing power cations (Si) form the largest number of bonds with the most polarizable anions (bonded to Al). This condition would be realized if one-third of the Si cations shared two of their four anions with two Al cations and shared the other two anions with two other Si cations; two-thirds of the Si cations would share anions with one Al cation and three Si cations. This association results in polymerized Si—O—Si—O—Si—O—Si—O chains alternating with (but bonded to) chains of Si—O—Al—O—Si—O—Al—O that pass through the feldspar so as to produce periodically uniform bond conditions. "Partially disordered" feldspars could have the same cation associations, but the periodic uniformity would be lacking. Disordered feldspars could have some Si cations sharing anions with three Al cations and other Si cations sharing anions with four Si cations. One Al sharing an anion with another Al is unlikely, as is evidenced by the lack of Al-Si disorder in anorthite (*2*).

If the orientation of the chains in the mineral could be determined, the ordered configuration of the Na and K feldspars would be known. Three possibilities are present: the chains may parallel either the *a*, the *b*, or the *c* crystallographic axis. Chains parallel to the *c*-axis are such that two Al, Si positions per unit cell are not included in the chains. These two positions are included if the chains spiral along their length, but such chains would not occur because this results in some improbable bond combinations, such as

Al—O—Al, and in Si sharing anions with three Al or four Si cations. Chains parallel to either the *a*- or the *b*-axis include all the Al, Si positions in the chains. Chains parallel to the *a*- and *c*-axes are the straightest and contain relatively uniform bond angles throughout their length. Chains parallel to the *c*-axis traverse the unit cell with three Si—O_4 or Al—O_4 tetrahedrons, and chains parallel to the *a*-axis traverse the unit cell with four tetrahedrons. A chain of six tetrahedrons is necessary to traverse the unit cell parallel to the *b*-axis, and this chain must wind along its length with nonuniform bond angles. Because of its greater length and its distortion around the alkali ion positions, it is suggested that the *b*-axis chains would not be produced in feldspar crystallization.

In polymerized compounds, the direction of greatest polymerization is the direction of elongation in the habit of the crystal. Inasmuch as the chains in feldspar represent the direction of principal polymerization in the mineral, the orientation of the chains should be manifested in an elongation of the crystal in the direction of the chains. The habit of K feldspar often displays a longer length parallel to the *c*-axis than is parallel to the *a*- or *b*-axis. Some crystals show a relatively elongated *a*-axis, but I have not seen an elongated *b*-axis. The Na feldspars are similar to the K feldspars except that an elongated *b*-axis is present in the pericline variety of albite. If the crystal elongation is related to the chains and if the three possible orientations of the chains are energetically equivalent, there should be an equal number of crystals in any rock with each of the possible orientations. In the specimens examined, all crystals showed either *a*-, *b*-, or *c*-axis elongation with no mixtures of the different elongated forms. Consequently, the chain orientation of the crystals is not an accident of nucleation but is primarily controlled by the environment of crystallization.

Prior to crystallization, polymerized groups of Al and Si tetrahedrons form, as is evidenced by the high viscosity of their melts. If the alkali ions can form more or less stable bond associations with these Al, Si groups, the Al—O—Si—O—Al—O—Si and Si—O—Si—O—Si—O—Si chains parallel to the *a*-axis would be favored over other orientations, because the alkali ion density is greater parallel to the *a*-axis than in other directions and because chains parallel to these alkali ions rows would reduce the bond energy of the group. High temperatures and/or low alkali ion concentrations would tend to decrease the amount or the importance of the alkali ion association with the Al, Si groups and, therefore, reduce the alkali ion influence on the chain orientation. Hence, at high temperatures and/or low alkali ion concentrations, the orientation of the chains or partial chains would be predominantly controlled by the kinetic energy of the Al, Si, group and, thus, the shorter *c*-axis chains would be favored. Also, under high alkali ion concentrations, the (010) "faces" of these Al, Si groups would tend to have a high alkali ion association that would establish the *a*-axis orientation but would also increase the rate of growth parallel to the *b*-axis. In other words, the growth parallel to the *b*-axis might not be as interrupted by the positioning of the alkali ions as it would be if the alkali ion concentration were lower, and this effect would be more pronounced in the relatively strongly bonded Na feldspars (pericline) than in the relatively weakly bonded K feldspars.

Additional evidence for the presence and orientation of the predicted chains is found in the crystallographic orientation of the quartz grains intergrown with feldspars, such as in graphic intergrowths and myrmekite. Drescher-Kaden (*3*) has discussed the relationships of quartz to feldspar and has pointed out that the *c*-axes of the quartz grains are commonly inclined 42° to the *c*-axis of the related K feldspar and are inclined about the same amount for the Na feldspars. The quartz *c*-axes are roughly concentrated into six fields about the feldspar *c*-axis with different specimens forming the different fields. Drescher-Kaden illustrates other quartz *c*-axis orientations inclined in zones roughly 70° and 20° to the feldspar *c*-axis. This orientation of quartz intergrown with feldspar is readily expected if the Si—O—Si—O—Si-type chains are present in the ordered or partially ordered feldspar, because chains of identical configuration are present in the quartz crystal and are inclined 42° to the quartz *c*-axis. If quartz nucleates on the Si—O—Si—O—Si chains in the feldspar, the quartz *c*-axis would be inclined 42° to the direction of the feldspar chain which, if the chains are parallel to the feldspar *c*-axis, would also be inclined 42° to the feldspar *c*-axis. If the chains are parallel to the *a*-axis, the *c*-axes of the quartz would be inclined either 18° or 72° to the *c*-axis of the feldspar. The baveno feldspars, which are elongated parallel to the *a*-axis, have the associated quartz *c*-axes inclined roughly 70° to the feldspar *c*-axis (*3*). These feldsparlike chains are present in six directions in the quartz crystal, all inclined 42° to the quartz *c*-axis, and this accounts for the six fields of points for the quartz *c*-axes around 42° and 70° zones. Short-range order but long-range disorder in feldspar could account for the scattering of the quartz *c*-axes that is found in some of the specimens.

It is concluded on the basis of crystal habit, quartz orientation, and bond energy considerations that the ordered Na and K feldspars contain Si—O—Si—O—Si and Al—O—Si—O—Al—O—Si-type chains oriented either parallel to the *a* or *c* crystallographic axes of the feldspar.

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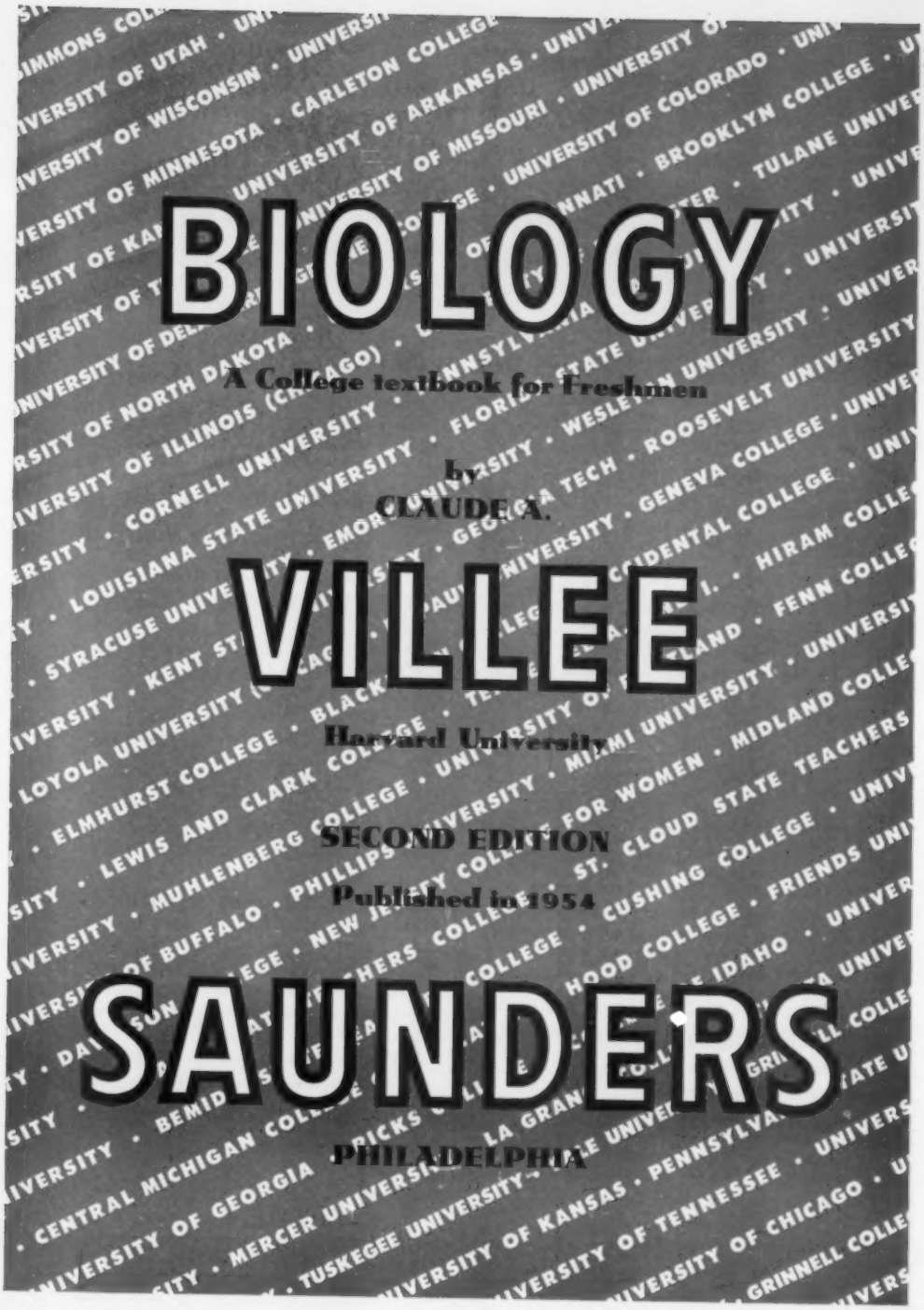
23 February 1955.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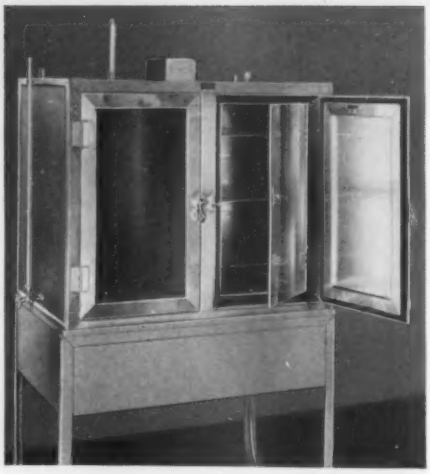

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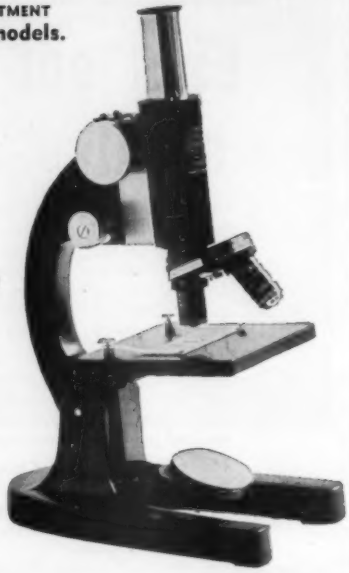

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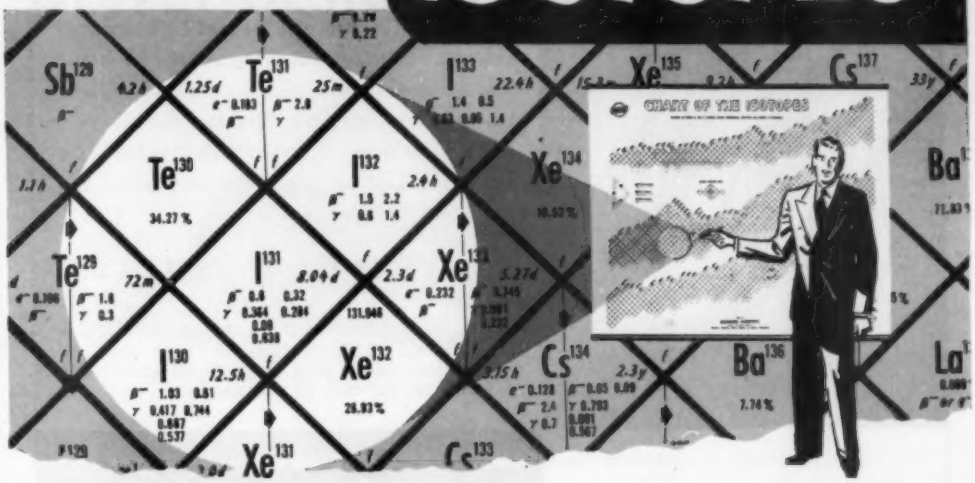

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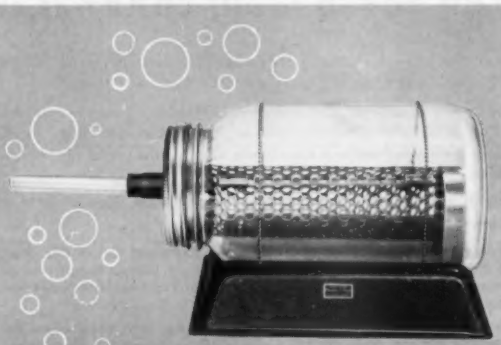

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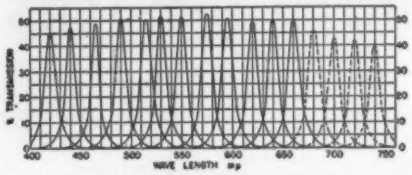

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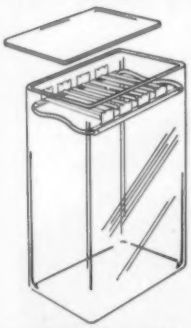

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Prizes and Awards

ELSEWHERE in this issue appears the first public announcement of the AAAS–Anne Frankel Rosenthal Memorial Award for Cancer Research, a new award to be made for the first time at the 1955 annual meeting. A few weeks ago [*Science*, 11 March 1955] the Association announced the resumption of the annual Socio-Psychological Prize, which is now financed on a long-term basis by an anonymous donor who wishes to stimulate the wider use in the socio-psychological area of the kind of rigorous methodology that has proved so fruitful in the natural sciences.

Each such research award poses problems, and not all awards that have been offered to the Association have been accepted. Beyond the fact that the administration of an award is a costly affair in terms of the amount of time devoted to it by already busy judges is the more important question of whether the award will in fact accomplish its purpose of stimulating better research. In the case of these two awards the answer will not be known for some years.

If they succeed as well as have the Association's older awards, the money and time will have been first-rate investments. The AAAS–George Westinghouse Science Writing Awards, although no longer being awarded, are generally credited with having had a worth-while effect in stimulating and rewarding excellence in science writing.

The Theobald Smith Award in Medical Sciences was started in 1936 and has been awarded 10 times. It goes to a person under the age of 36 for research in the medical sciences that shows independence of thought and originality. The award is supported by Eli Lilly and Company.

The oldest of the Association's awards is the Newcomb Cleveland Prize. Started in 1923, the award was made for the 27th time at the Berkeley meeting. It is given, preferably to a younger scientist, in recognition of an outstanding contribution to science, which is reported at the Association's annual meeting.

Last December at Berkeley, after the 1954 winner, D. H. Alpert, had been presented with a check for $1000, and after the news photographers and reporters had kept him busy for an hour or so, George Beadle and I started reminiscing about previous winners. They are a distinguished group. Three have since won Nobel prizes. H. J. Muller won the Association's Thousand Dollar Prize, as it was known until after the modest donor died in 1927, and a Nobel prize in 1946; Wendell Stanley, the 1936 winner, received a Nobel prize in 1946; and I. I. Rabi, who received the Association's prize in 1939, became a Nobel laureate 5 years later. Other winners, although not so fortunate as to have their names on the Nobel list, have continued to make distinguished contributions to science; L. E. Dickson, E. P. Hubble, D. C. Miller, G. D. Birkhoff, A. J. Dempster, M. A. Tuve, L. R. Hafstad, and others illustrate the high caliber of the roster.

Rabi, the most recent of the group to be honored by a Nobel award, was the 22nd winner of the Association's prize; three Nobel laureates out of 22 men selected by the award committees is a proud record. How much the Association's prize helped these men to greater achievements no one can say. But their contributions and the fact that one in seven of them have since received the highest honor that can come to a scientist must be an inspiration to the 17 men and women who have been awarded the Association's prize since Rabi received it in 1939.

Beyond the effects on individual winners is the larger effect on scientists as a whole. Although an individual does not compete for these prizes as athletes compete for Olympic medals, their existence adds a bit to the pleasures of research for its own sake. And to the public at large they are an annually recurring reminder of the importance of fundamental research.—D. W.

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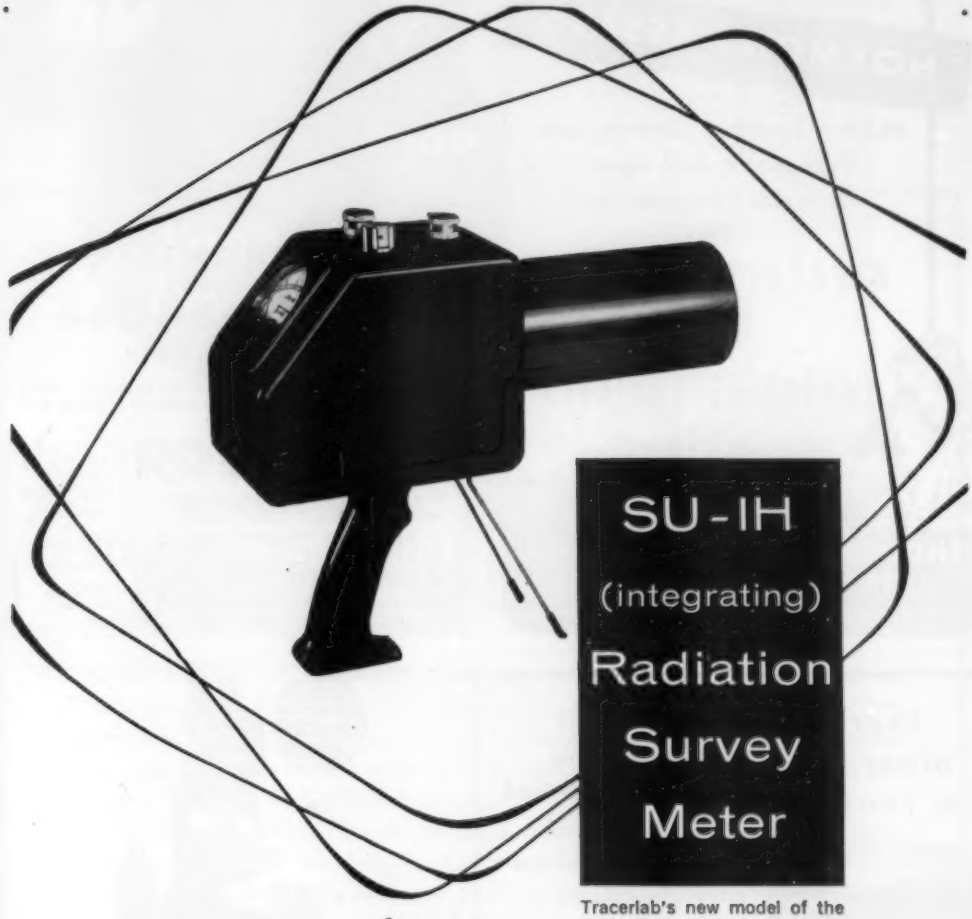

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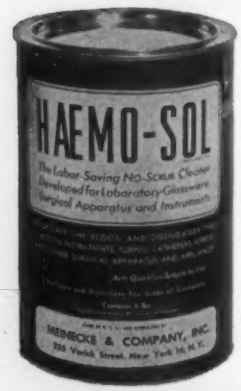
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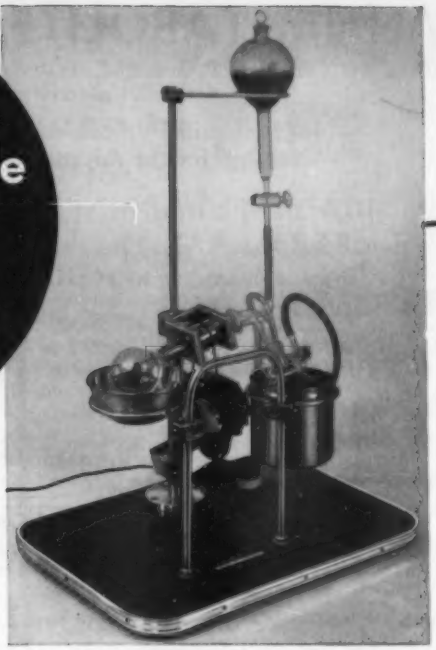

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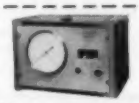

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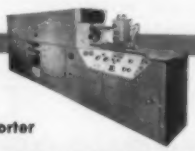

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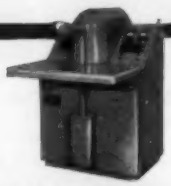

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Meetings & Conferences

June

13–15. American Neurological Assoc., 80th annual, Chicago, Ill. (H. H. Merritt, Neurological Inst., 710 W. 168 St., New York 32.)

13–16. National Organic Chemistry Symposium, 14th, Lafayette, Ind. (W. E. Parham, 347 Chemistry, Univ. of Minnesota, Minneapolis 14.)

13–17. American Soc. of Civil Engineers, St. Louis, Mo. (W. N. Carey, ASCE, 33 W. 39 St., New York 18.)

13–17. Symposium on Molecular Structure and Spectroscopy, annual, Columbus, Ohio. (H. H. Nielsen, Ohio State Univ., Columbus 10.)

13–22. International Commission on Illumination, plenary meeting, Zurich, Switzerland. (C. A. Atherton, International Commission, Hopkinton, N.H.)

14–16. Conf. and Exhibit on Magnetics, Pittsburgh, Pa. (R. Rimbach, 845 Ridge Ave., Pittsburgh 12.)

15–17. Brookhaven Symposium in Biology No. 8, annual summer conf., Upton, L.I., N.Y. (R. C. King, Dept. of Biology, Brookhaven Natl. Lab., Upton.)

15–17. Joint Conf. on Combustion, American and British, Boston, Mass. (American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18.)

15–18. Colloquium of College Physicists, annual, Iowa City, Ia. (G. W. Stewart, Dept. of Physics, State Univ. of Iowa, Iowa City.)

16–18. Symposium on Microscopy, 6th, Chicago, Ill. (W. C. McCrone, Armour Research Foundation, Chicago 16.)

17–19. Soc. of Nuclear Medicine, Portland, Ore. (A. Livermore, Reed College, Portland.)

20–23. American Soc. of Mechanical Engineers, semiannual meeting, Boston, Mass. (O. B. Schier, 29 W. 39 St., New York 18, N.Y.)

20–24. American Assoc. of Physics Teachers, joint meeting with American Soc. for Engineering Education, State College, Pa. (M. W. White, Pennsylvania State Univ., State College.)

20–24. British Medical Assoc. annual, Toronto, Ontario. (A. D. Kelly, Canadian Medical Assoc., 244 St. George St., Toronto 5.)

20–25. AAAS, Pacific Div., Pasadena, Calif. (A. W. Galston, Biology Div., California Inst. of Technology, Pasadena 4.)

20–25. Symposium on Electromagnetic Wave Theory, Ann Arbor, Mich. (J. W. Crispin, Jr., Univ. of Michigan, Ypsilanti.)

21–23. American Dairy Science Assoc., East Lansing, Mich. (E. Weaver, Dairy Dept. Michigan State College, East Lansing.)

21–23. American Meteorological Soc., Pasadena, Calif. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

22–24. American Physical Soc., Toronto, Canada. (K. K. Darrow, APS, Columbia Univ., New York 27, N.Y.)

24–2. International Statistical Inst., 29th annual, Rio de Janeiro, Brazil. (ISI, 2 Oostduinlaan, The Hague, Netherlands.)

26–1. American Soc. for Testing Materials, annual, Atlantic City, N.J. (R. J. Painter, 1916 Race St., Philadelphia 3, Pa.)

26–1. National Education Assoc., Chicago, Ill. (W. G. Carr, 1201 16 St., NW, Washington 6, D.C.)

27–29. American Nuclear Society, 1st annual, University Park, Pa. (W. W. Miller, Pennsylvania State Univ., University Park.)

(See issue of 22 April for more comprehensive listings.)

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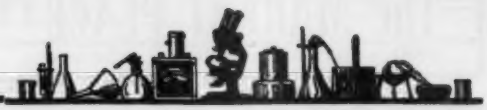

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